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NIAGARA MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY.

The meeting at Niagara last week of the American Electrochemical Society again demonstrated the great value of this youngest of the technical societies to the profession and the industry which it represents. Not the least of its claims to the highest consideration is that its founding made known what until then the world had ignored, namely, that there existed in this country a body of workers in the field of electrochemistry who in ability and zeal rank second to none in the world; and the members of this body the society has, in the short space of less than two years, firmly united in professional solidarity and imbued with an esprit du corps equal to that of any of the older professional societies. The fact that the attendance at Niagara and the number of papers there read were somewhat below the average of the former meetings, is not to be taken as indicating that interest in the body is slackening, but rather merely as repeating the sometime experience of almost all similar bodies that two general meetings a year are one too many.

Of the papers read, that by Prof. Bancroft on "Electrolytic Copper Refining," was without doubt the most important presented at the meeting. The investigation which the paper records was equally excellent in scope and in method. The data obtained show conclusively the relation under definite conditions between current efficiency, current density and temperature in four different electrolytic solutions, three of the solutions being those in commercial use, and the fourth one for which a claim of superiority has been made. The admirable feature of the paper is that the data were determined under such conditions that any given refinery can by simply supplying the further data relating to the particular conditions of operation of its plant, determine if the economy which the experiments indicate can be realized in that particular case. In the discussion this feature of the plan of investigation appears not to have been fully realized, some of the speakers criticizing the conclusions of the paper through misunderstanding that these conclusions were not offered as general in their scope, but rested on assumptions representing only a portion of the factors entering into the commercial problem, the other factors being known in the case of any plant, and easily combined with those given for the solution of the economic problem as a whole.

Another valuable paper presented was that of Mr. Brown on "Nickel Plating." Heretofore, in this industry knowledge of the processes appears to have been almost entirely empirical, based upon experience alone without reference to the underlying principles. The paper discusses the fundamental principles and sets forth data by the aid of which the nickel plater can carry out his processes in a much more intelligent manner than in the past has been done, and, moreover, extend them successfully to meet exceptional conditions. An interesting paper was that by Prof. Burgess on the "Passive State of Iron," in which he showed how the passive electrical state which iron assumes under certain conditions has been taken advantage of industrially in electrolytically removing from steel tubing the brass left on the outside as a superfluous material during a brazing process. The discussion on the dissociation theory was a disappointment to those who expected it to be, par excellence, the enlivening feature of the meeting, its opponents being much more moderate in their tone on an occasion when specific criticism rather than general denunciation was called for. It was pointed out by those who have

remained neutral in the controversy that instead of a theory, the generalization is, properly speaking, only a hypothesis; and that independently of its validity as a whole, it has been of much service in the development of modern electrochemical science.

THE NATIONAL BUREAU OF STANDARDS.

Elsewhere we reprint that part of a recent report of the National Bureau of Standards which refers more particularly to what has been accomplished in getting into working condition the departments of the Bureau dealing with electricity, thermometry and pyrometry. As will be seen, the electrical standards equipment of the Bureau is already quite creditable in several branches, and work is progressing satisfactorily in the remaining ones. At present there are facilities for the comparison of resistances covering a wide range, and for the calibration of direct-current ammeters up to 600 amperes and direct-current voltmeters up to 300 volts, as well as for the calibration of direct-current wattmeters, presumably for the same limits of current and voltage. The equipment for the testing and calibration of condensers and the measurement of inductances is also quite complete. When the alternating-current department, which is now in hand, is similarly developed, the Bureau will be able to meet any demand likely to be made upon its service by the electrical industry, as well as by the various laboratories of the country. During the campaign for the establishment of the Bureau, perhaps the most effective aid was that which was lent by the electrical interests; and it is a great pleasure to know that Dr. Stratton and his able corps of assistants are making every effort to render the Bureau of the highest service to the electrical arts and to experimental electrical science.

OVERHEAD POLE LINE CONSTRUCTION FOR CENTRAL STATIONS.

At the recent convention of the Association of Edison Illuminating Companies this topic was discussed in a paper that we have reprinted in part on page 510. The subject is of great and increasing practical importance. Many power transmission circuits already stretch across the country, and more are destined soon to appear. The average length of these lines increases from year to year, as the voltage of transmission increases. Ten years ago five kilovolts would have been considered a high pressure. At the present time a high pressure would be from forty to sixty kilovolts, while at no very remote period in the future we may expect to see even these pressures largely increased. It is not only that high-pressure lines are appearing in greater numbers and in greater lengths, but also that low-pressure wires and signaling wires are being erected in increasing numbers. In telegraphy, on this continent, there is practically no machine transmission. Nearly every wire is worked on the Morse system by hand. When the traffic increases beyond the capacity of a single wire, the managers put up another wire. Similarly, in telephony, every new long-distance circuit calls for two more overhead copper wires, in the open country. Then the trolley feeders have to be carried overhead in interurban districts. The result is that overhead wires parallel to each other and overhead wires running at intersection, increase and multiply from year to year. There are already places in this country where six separate lines of poles run parallel and side by side only a few yards apart from each other. Some of these places, moreover, are not in the immediate neighborhood of cities.

The danger of accidental crosses between high-pressure wires and signaling wires is, therefore, constantly on the increase, unless steps are taken to lessen the danger, by special precaution, as fast as the growing multiplicity tends to increase it. While there can be no doubt about the increase of the danger through increase in the number of wires crossing each other's paths, yet there can also be no doubt that adequate construction will minimise the risk. The suggestion of the casual citizen, unversed in the subject, is to bury the wires underground. This plan is very satisfactory within city limits, but outside cities it becomes quite impracticable, the expense alone being prohibitive. Besides, long-distance telegraph and telephone wires must go overhead in order to be workable. The long-distance transmission wires must go overhead, in order to maintain their insulation. Every line of reasoning, therefore, returns to improvement in line construction. This means systematizing and standardizing the construction, in such a manner as to secure the most uniform and most reliable disposition commercially possible.

As pointed out in the paper, the principal objection to pole lines on the part of the public is their ragged and unpleasing appearance. This disregard of æsthetic appearance has often been specially charged to American overhead lines by European electrical engineers, who are accustomed to see and to construct trim and handsome lines at a considerable additional expenditure of care and money. The charge is to a great extent condoned by the great length of telegraph and telephone lines that have to be erected over uncultivated lands, in order to connect cities that lie remote from one another, and where any extra care expended upon appearances would be thrown away to the wild woods. The denser and older civilization of Europe has rendered more care necessary upon the appearance of its pole lines, as well as upon the appearance of its railroads. The same influences are, however, steadily at work on this continent tending to improve the appearance of pole line construction in suburban districts. There can be no doubt that a smart and trim pole line becomes an ornament to a landscape; or, at least, escapes being an eyesore. Moreover, such pole lines are apt to require the least expenditure in repairs, and are the least likely to get into trouble by falling upon other wires at intersections.

The paper discusses the details of pole line construction as modeled upon experience in the strenuous suburbs of Philadelphia, and contains a number of excellent suggestions. Complete specifications are offered for the uniform safe support and connection of transformers on individual poles, so as to provide immunity from accidental crossing between primary and secondary wires on the pole, as well as safeguarding the lineman who may have to change the fuses of the transformer during a time when the high-pressure wires are alive. In conformity with the best practice, the paper recommends the grounding of secondary circuits. Every year of experience with increasing primary pressures emphasize the importance of permanently grounding secondary circuits in order to prevent the possibility of bringing the secondary circuit to primary potential through any accidental cross, inside or outside of the transformer. With only low-pressure grounded electric light wires or properly protected telephone wires entering consumer's premises, the risk of accidental shock, or of danger from fire consequent upon accidental crosses outside, may be practically eliminated; while if standard line construction is everywhere followed, the chance of accidental crosses becomes itself remote.

It is to be hoped that all the electric lighting and power companies will unite their influences in maintaining the character of suburban overhead construction. The danger of accidental crosses is greatest with careless, wastefully cheap and slip-shod construction, while a single bad accident due to a cross between an overhead high-pressure and telephone wire may bring discredit in the public indiscriminating eye upon the carefully and the carelessly engineered company alike. Experience has hitherto indicated that there is considerably more chance of a cross between telephone wires and alternating-current distribution wires at one kilovolt or two kilovolts pressure,

than between telephone wires and transmission wires at many kilovolts pressure. This may be due in part to the greater prevalence of distribution circuits; but it is also due, in part, to the greater care and more substantial construction which is exercised in the erection of long-distance high-pressure transmission lines. The high-pressure wires mean a great gain to the community supplied by them. They are destined to spread. It is, therefore, necessary to see that they are safely erected.

ONS AND IONS.

The communication elsewhere in this issue from Mr. Bowker sets forth an interesting hypothesis covering a great range of natural law. It seeks to cover the leading properties of ether, matter, chemical affinity, cathode rays, Röentgen rays and spectrum analysis. In the natural history of scientific discovery there is first a period during which facts are being collected. This is the purely analytical period, in which all the energies of investigators are being directed towards the collection of new material or fact discovery without any attempt to coordinate the facts or assimilate them. After the expiration of this period comes the second or synthetic period, in which effort is made to collate the data as distinguished from collecting them. In this period the laws controlling the phenomena are discovered and reduced to the form of theories. A theory, if competent, is therefore the crowning arch over columns of observations. The completed structure is grander and more imposing according to the amount of fact material which the arches span. In the natural history of ions and the science connected with them, the most recent analytical development has been so rapid, and so rich has been the harvest of fact material open to the scythe of investigation, that there has been but little opportunity for the second and synthetic period to inaugurate the theory that may aggregate and collocate all these new facts. Nevertheless, some synthetic propositions have been already brought forward, and Mr. Bowker's proposals are on the welcome list.

It has already been suggested that, in view of recent developments in ionic investigation, all matter may be composed of a single mother-substance—protyle. This protyle is supposed to be manufactured by destructive processes from concrete matter in the Crookes tube. Protyle is regarded as being composed of corpuscles, or the chips of matter which may go to build up atoms. According to that hypothesis, there are about one thousand chips of protyle in a single atom of hydrogen, and, therefore, about two hundred thousand chips of protyle in an atom of mercury. All chips of protyle are alike and indistinguishable. One particular structure of chips builds up a stable structure which may be known as an atom of nitrogen, and another particular structure having a different number of chips, differently organized, may be known as an atom of uranium. Concerning the forces which hold together the chips of protyle inside any atom, the existing hypothesis, itself a speculation, becomes yet more speculative. It has been supposed that the chips are themselves inherently electrically charged, or are corpuscular electric charges, and that they gyrate in orbits like lilliputian asteroids, with frequencies which correspond to the frequencies of spectrum analysis requirements. The internal energy of an atom, part of which may be released by rearrangement under chemical synthesis in the formation of new molecular structures, has been supposed to come from the energy of planetary movement of the chips within the atom. The presence of these protyle chips, with their relatively large independent electrical charges in an atom, seems to offer as satisfactory explanation for mechanical inertia, as observed in masses of matter. Gravitation has also been accounted for in a less satisfactory manner. Electrolytic conduction, gaseous conduction, and solid conduction, have all been explained by the existing proposals to a greater or less extent. But while all this theory has already been suggested, it comes rather from different persons at different times than from any single paper or text-book with which we are familiar.

Mr. Bowker's paper contains an independent effort to develop the most recent ionic theory, and is largely consonant with the speculations already offered. Mr. Bowker goes a step further, however, than the speculations we have seen. The chemistry of ancient times postulated the molecule of matter under the title of atom, as the minimum divisible, or smallest thinkable piece of matter. The chemistry of ten years ago regarded the atom, or component part of a molecule, as the smallest thinkable, or smallest postulable part. The recent ionic chemistry regards the ion, electron, corpuscle or chip (using these terms synonymously) as the smallest postulable piece of matter and builds atoms out of protyle, just as molecules are built of atoms. Mr. Bowker carries us yet another step, and regards the corpuscle as distinct from the passive "on." According to his view, the universal ether is made of motes of passive material called "ons." Some particular energization of an on or of "ons" makes up a corpuscle, if we apprehend his view correctly, and then corpuscles become atoms, and atoms molecules, which we might finally distinguish, if we could catch them and hold them quiet in the field of an enormously powerful microscope not yet designed or conceived. The essential difference, therefore, as we understand it, between Mr. Bowker's hypothesis and the existing hypotheses, lies in the fact that he builds the ether out of the same stuff as he builds corpuscles, and this mother stuff is "ons." The ons which lie helter-skelter in myriads to form his universal ether are energized here and there into material corpuscles or ions. What the process is that prefixes an i to an *on*, to convert it into an *ion*, or what is the difference between an *on* and an *ion*, is not suggested. An existing hypothesis, however, regards the corpuscle or ion as an energized piece of ether, just in the same way that a vortex-ring, or smoke-ring in air, is an entity derived from air by a particular energy-differentiation. On this theory, the ether, alone and quiescent, is a sort of universal fluid, and the material elements or ions are, say, vortex spirals floating in it. On this view, matter and ether are the same except that the latter is energetically inert, while the former is active or energized.

This speculation differs only then from Mr. Bowker's in that it leaves the nature of the ether in the tacit shade of mystery, and starts with ether as filling all space somehow; whereas Mr. Bowker, more conscientiously, starts with complete emptiness in space, and then fills it with separate similar ons like myriads of micrococci in order to make the universal ether. In either case the transition from ether to matter takes place through the portals of energy. Assuming that all this were true, the hypotheses would naturally converge to the expectations that not only matter might be transmuted through protyle from one form to another, say, from lead to gold—the old dream of the alchemists—but that also matter, as protyle, might be created out of ether by discovering the particular method used by nature in the past or present for blowing soap-bubbles, or generating vortex-rings, out of the ether. It is not only perfectly conceivable, on such a hypothesis, that matter might be created, destroyed, or exchanged, but it is even to be expected that the process might some day be discovered of doing deliberately and artificially that which the forces of nature may have done sporadically and automatically in the unending past. All this, however, is merely speculation, and without the limitations imposed by the existence of facts, the number of such speculations may be multiplied ad infinitum.

Report of the National Bureau of Standards.

With regard to the work of the National Bureau of Standards, Dr. S. W. Stratton, its director, gives some interesting details in relation to electrical matters. The electrical work of the bureau during the year was divided into two parts, the first including the construction and verification of resistance standards and standards of electromotive force, the calibration of resistance boxes, Wheatstone bridges, potentiometers and other resistance apparatus, direct-current measuring instruments, etc., and the second embracing the verification of photometric standards. This work has been subdivided into the following subjects: 1. Primary and secondary mercurial standards and resistance standards of precision. 2. Resistance boxes. 3. Standards of electromotive force. 4. Ammeter and voltmeter testing, and verification of resistance standards for current measurement. 5. Photometry.

Dr. Stratton says:

"At present resistance measurements of the bureau are referred to a number of 1-ohm manganin standards, reverified from time to time at the Physikalisch-Technische Reichsanstalt, which are, therefore, known in terms of the primary mercurial standards of that institution. The construction of secondary mercurial standards is now under way.

"The set of resistance standards of the bureau has now been completed and consists of ten 1-ohm coils and four coils of each of the following denominations: 10, 100, 1,000, 10,000, 100,000, 0.1, 0.01, 0.001 and 0.0001 ohms, together with two 2-ohm, three 3-ohm, two 5-ohm coils and two megohm boxes, so that there are on hand in most cases two reference standards and two working standards of the same denomination. Two 0.00001-ohm standards are under construction.

"The materials for a new lot of standard cells have been purchased from a number of leading manufacturers. The cells are to be set up in the immediate future. Arrangements have been made with the Weston Electrical Instrument Company for the loan of a dozen cells of the portable type, to be used in determining the relation between the standard cells of the bureau and those of the English and German institutions.

"A laboratory has been equipped for the calibration of direct-current ammeters, voltmeters and wattmeters, and the verification of resistance standards for the measurement of very large currents. The present range is 600 amp. and 300 volts, but will be considerably extended in the near future. The resistance standard of lowest value of the bureau is 0.0001 ohm. Standards of considerably smaller resistance can, however, be accurately calibrated. The double-bridge method is employed.

"Facilities are now provided for the verification of resistance standards of precision and standard cells, the calibration of resistance boxes and other resistance apparatus, ammeters, voltmeters, wattmeters, watt-hour meters, the verification of resistance standards for current measurement, the determination of the electrical conductivity and the temperature coefficients of materials.

"The second part of the electrical work has included the measurement of electrical inductances and capacities, and the testing of inductance coils and condensers, and the preparation for alternating-current measurements of a wider range.

"The bureau is now prepared to measure the capacity of condensers by various methods, expressing it in terms of the standards of the bureau, and to test condensers for leakage, absorption and temperature coefficient. The bureau is also prepared to measure inductances in terms of its standards, and will shortly be prepared to measure both inductances and capacities in absolute measure.

"The calibration of alternating-current voltmeters and ammeters will begin in the near future, as well as the testing of alternating wattmeters and watt-hour meters, frequency indicators, phase indicators and other alternating-current apparatus."

In regard to thermometry and pyrometry, the report says: "For scientific work requiring the highest attainable accuracy in the measurement of temperatures in the interval 0° to 100°, this bureau is now in the possession of five Baudin thermometers of the highest perfection of workmanship, and eight Tonnelot thermometers, all of which have been carefully studied at the International Bureau of Weights and Measures, and thus serve to define the connection of the temperature scale used by this bureau with the international scale of temperature of the hydrogen gas thermometer. The bureau has further prepared specifications and is now having constructed by Richter, of Berlin, a number of primary standard mercurial thermometers that are to be carefully studied at and compared with the standards of the Physikalisch-Technische Reichsanstalt.

"Specifications have been prepared and primary standard mercuria thermometers are now being constructed by Niehle, of Berlin, and by Baudin, of Paris, for work in the interval 100° to 550°. The specially-designed platinum resistance thermometers have been constructed by the Cambridge Scientific Instrument Company, and have just been received by this bureau. A special Wheatstone bridge resistance box has been designed for use with these platinum thermometers and is now nearly completed. The comparison baths for work in the interval 100° to 550° are now being designed and the necessary parts assembled, so that the bureau will be in a position in the course of several months to certify thermometers up to 550° C.

"For the testing of pyrometers in the interval 500° to 1500° C., much of the necessary apparatus is now in hand. As standards the bureau is in the possession of several platinum and platinum-rhodium thermo-couples, which have been compared with the standards of the Reichsanstalt, in addition to a number of thermo-couples from other sources, and as soon as these have been recalibrated and intercompared the bureau will be in a position to certify pyrometers for the public. The platinum thermometers will also serve as standards up to 1000° C. For the testing of pyrometers the bureau has available several small gas furnaces, several electric furnaces with necessary regulating rheostats, two radiation pyrometers with an electrically-heated "black body" for the calibration of radiation pyrometers, a specially-designed potentiometer suitable for thermo-electric work, a Callendar recording pyrometer, etc. A very thorough digest of the most important work done in the field of high temperature measurement from 1830 to the present time has been prepared.

"The bureau is at present prepared to certify clinical thermometer mercurial thermometers in the interval —30° C. (—22° F.) to + 100° C. (212° F.), and thermo-couples in the interval 0° to 1500° C. (2700° F.)."

Trains for the New York Subway.

Tests have been made lately on the Manhattan Elevated road with a five-car train of the style intended by the Interborough Railway Company for the underground road. Some details of the fireproof features have already been given in these columns. Mr. Frank J. Hedley, the general superintendent of the Interborough Company, himself explained the automatic brake system on the cars, as follows:

"The cars carry two lines of air pipes, known as a main reservoir and a train-line pipe. When the train is in motion the main reservoir line is charged with 90 pounds of compressed air to the square inch. The air is compressed by means of electrically-driven compressors, which are installed under each motor car. When the train is in motion the train-line pressure is so regulated that 70 pounds pressure to the square inch is carried, and any reduction in the train-line pressure causes the brakes on the entire train to set automatically and simultaneously. The train-line pressure is coupled with the electric controller, and if at any time while the current is being fed into the motors the motorman should for any reason take his hand off the controller when the train is in motion, the brakes are at once set on the entire train. Just before the brake is automatically set the current is cut off from the motors on the entire train. This also is done automatically.

"The cars are also equipped with what is known as the conductor valves. These valves are provided with cords which run through the trains and upon the platforms, so that any conductor anywhere on the train can set the brakes immediately. In addition there is an automatic stop valve on each truck. Should any motorman at any time run past a danger signal the brake will immediately set and his current be cut off, thus making it impossible for him to run far beyond a danger signal.

"There are no gates on the cars, but sliding doors in the vestibules. They are opened and closed by means of levers. The windows open from the top, instead of the bottom, as on the elevated cars. Each train will have eight cars, five of them motor cars, and three trailers. Five hundred cars are at present being built. They will all be run on the Second Avenue elevated line during the winter, and the cars now running on that road will be distributed over all the lines." Mr. Hedley also repeated what has already been set forth as to the steps that have been taken to protect the cars from fire and the passengers from any fire due to short-circuits, collision, etc.

A Theory of Ons: In Reconciliation of the Undulatory Theory of Electricity With Ionization and the Electron Hypothesis.

BY R. R. BOWKER.

AFTER study of the most recent data on ionization and of the hypothesis of the electron as developed by Prof. J. J. Thomson, Sir Oliver Lodge and others, I venture to propose the following hypothesis, based on a homogeneous unit of primordial matter, which may best be called the "on" (from Greek ὠν, and as a logical primitive of *ion* and *electron*), in support of the undulatory theory of electricity and in reconciliation with it of the observed corpuscular phenomena.

It is now admitted and asserted by investigators that the "atoms" of "elements" are structures of component particles. The latest investigations confirm the indications of the Frauenhofer lines, which have always seemed to suggest, indeed to prove, that the elemental atom is composed of parts, whose frequencies of tonic and perhaps harmonic vibration produce the distinctive lines.

It is now also asserted that in all electrical conductors the constituent molecules, supposedly neutral or balanced electrically, are in part or in whole dissociated into electrically charged particles, which may be atoms or combinations of atoms, called by Clausius and Faraday, "ions."

It has long been proven that the most diverse physical properties may result from differences solely of arrangement of the same constituent particles, as is sufficiently illustrated by the fact that fifty-five allotropic compounds of $C_9H_{10}O_3$ have diverse and distinctive properties.

I state the proposed theory synthetically instead of analytically for greater clearness in statement.

It may be supposed that homogeneous ons, so infinitesimal as to be practically imponderable (which when passive and uncombined may constitute the space-medium or ether, responsive to and transmitting vibrations of all wave lengths) constitute when energized and combined ponderable matter, generating or transmitting vibrations of distinctive wave lengths selectively according to the nature of the combination.

It may be supposed that these ons constitute distinctively the "atoms" of the several "elements" by differences of numbers or of systems of arrangement. The distinctive groups or systems within the atom, like the strings of the piano, would give, by their different lengths or masses and thus distinctive tonalities, the characteristic spectrum lines. It is conceivable that the ons within the atom might be associated cohesively in inert groups as rods, plates or other solid figures, or in active vortex whirls, or in orbital rotation like the solar and stellar systems of astronomy, linking the infinitely great with the infinitely little.

It may be supposed that the distinctive elemental atoms are variants of one of these systems, or that the different orders of elements may have their atoms built on different orders of systems. It is conceivable, for instance, that the inert gases of the argon group may be inert combinations of ons, while the more active elements might be rotating orbital systems. It is claimed that rotating planes would give the doublets and triplets recently discovered among the Frauenhofer lines. It would seem probable that atoms of a small number of ons, therefore, or low atomic weight and comparatively simple structure, would occur most largely—as is actually the case.

It may be supposed that differences of energy would be shown in energized ons, atoms and molecules, either by excess or lack of normal energy, or by difference of vortex or orbital direction, thus manifesting positive and negative electric character. Thus atoms, and consequently molecules, having more positively electric ons, or "posons" than negatively electric ons, or "negons" (the original electron), would have positive electric character and would be satisfied or electrically neutralized only by combination with a substance having negatively electric ons in excess. Thus hydrogen and the other metallic elements would as a class have an excess of positive ons, or positive motion, and the non-metallic elements an excess of negative ons, or negative motion. It is conceivable that electric intensity might vary with the rapidity of the vortex or orbital motions.

It may be supposed that under conditions of extreme excitation, caused by vibrations of great intensity (as by extreme heat) or of high frequency (as in the case of ultra-violet, Röntgen and like rays), ons are separable from the atom, the degree or conditions of separability varying with the structure of the several elements and their physical relations. A like condition of an explosive separation of ons from the atom, and incidentally a breaking up of the molecule, partial or complete, might be developed under the exhaustion conditions of a Crookes tube under the influence of electric vibration, making the gas a conductor, producing the "fourth state of matter," and causing the cathode rays.

It may be supposed that the propulsive energy separating the ons from the atom would give the ons a high rate of speed, possibly in an orbit about the atom, in one direction, giving negative electricity, and that the reaction would give the larger atom a repulsion or rotation at a speed lower in inverse proportion to the larger mass, in the opposite direction, giving positive electricity. This suggestion seems to parallel the conditions of the supposed electron, while in accord with the undulatory theory and the conservation of energy.

It may be supposed that the degree of separability of the on from the atom differs with the atomic structure of the several elements. Thus the high atomic weights, indicating a large number of ons and correspondingly increased complexity of structure, of the new radioactive elements suggest that these may be of comparatively unstable structure or of unstable equilibrium, comprising ons or groups of ons easily separable as permanent emanations, either by the stored propulsive energy or by the conversion of energy from cosmic sources into this radioactivity. On this supposition three classes of radiations would be distinctively accounted for: one of actual corpuscles, the repelled ons, two of waves proper, arising respectively from the quick pulsations of the repelled ons and from the slower pulsations from the residual atoms. The separation of the ons might be in so small a proportion of the substance as to alter its physical properties comparatively little, producing possibly, however, such changes as have supposedly been noted in thorium. If the separable ons had a tendency to come to the physical surface of the substance, this might account for the resumption of radioactivity noted in thorium. The emanations of ons might constitute an inert gas, identifiable with the gases of the argon group.

It may be supposed that the conditions of separability of the on from the atom differ with the physical relations of the same substance, as in solid, liquid or gas. Thus the separation may be limited and temporary in the case of solid conductors, as copper, producing ionization during the passage of a current, while in liquid electrolytes, ons set free or repelled may transport with them in the process of convection as ions less active particles which, when the on surrenders its energy, appear at the odes again as atoms or molecules of the element or compound, the degree of decomposition depending upon whether the elements in a compound are electrically balanced, as in the case of some compounds, or are electrically unsatisfied. This suggestion is also in conformity with the observation that the negative ions of all gases are the same, and the view that the negative corpuscle (or electron) is perhaps a thousandth part of the atom.

To put this theory briefly, it suggests that the several elements may be constituted of different systems of homogeneous ons, whose relations of vibration within the atom produce electrical energy positive or negative according to the direction or other quality of the motion. I venture this hypothesis for the consideration and cross-fire of investigators.

Telephony in Abyssinia.

Emperor Menelek, of Abyssinia, it is stated, is establishing a complete telegraphic and telephonic system in that country. Both have been in operation for some years between the towns of Harar and Addis Abeba, and recently the seat of Government has been connected by telegraph with Jibuti, on the Gulf of Aden. There are thus more than 500 miles of telegraph line already at work in the empire, and recent extensions will increase the total length of line in use to about 1,200 miles. A telephone system now connects Asmara with Barromedia by way of Adowa, and Addis Abeba with Ankober. The Emperor has given permission to Italians to construct the line from Massowah on condition that it passes by Ankober, where political prisoners are detained. He receives daily reports by telephone from all parts of his empire. The southern frontier is not yet included in the system, but he has given orders that a telephone line 400 miles long shall be constructed there. The necessary material has already arrived in the country, and the work of construction will be carried on as rapidly as the conditions will permit.

Alternating Current Switchboards—I.

By Stephen Q. Hayes.

ONE of the most important, but often least noticed parts of an electrical installation is the switchboard, which has been described as the brain of an electrical system. This description is a very apt one, for a switchboard performs all the functions of controlling, protecting, measuring and regulating an electrical system that the brain performs for the human system.

The devices used for controlling are the switches which connect the various sources of power, such as generators, transformers, batteries, etc., feeding into the switchboard, and the feeders, etc., feeding out. Protective devices such as fuses, circuit-breakers, etc., are to protect the various apparatus from damage due to excessive current, etc. Measuring devices comprise the various ammeters, voltmeters, wattmeters, etc., used to indicate and record the output of the various circuits. Regulating devices cover rheostats and regulators of various kinds. In the design of switchboards, as in the design of everything else, there are three points always to be borne in mind: 1st. Work to be done. 2nd. Method of doing the work. 3rd. Cost of doing the work.

In any given case the work to be done is usually clearly understood and definitely known, but the method of doing the work and its cost is subject to many possible variations.

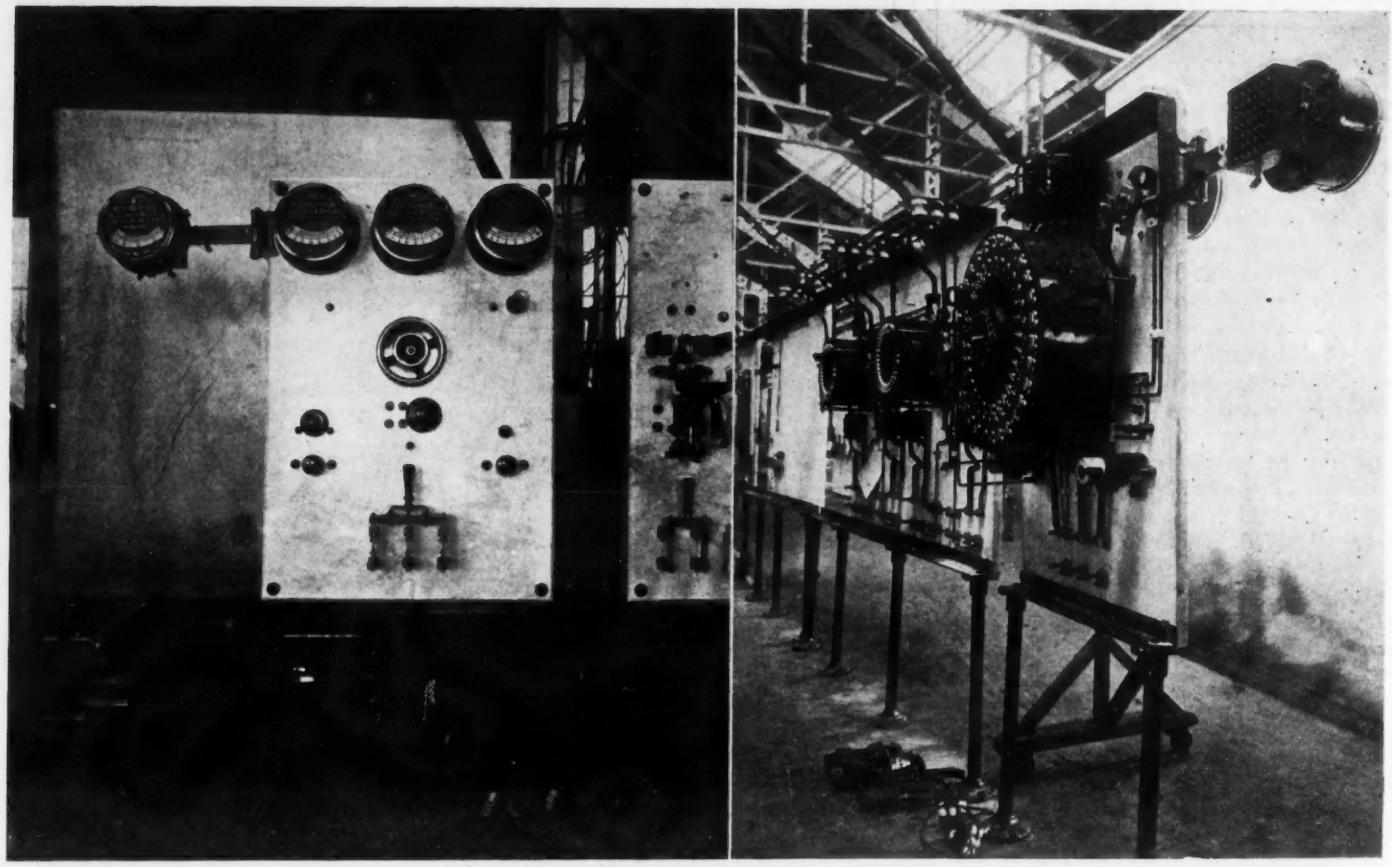
One man may want the cheapest switchboard that will do the work while another wants the best irrespective of price. Between these two limits there is a very wide range, and it is part of the duties of a designer to be able to meet all conditions and supply a board that will be satisfactory as regards cost and completeness.

With this end in view standard lines of switchboard panels have been designed to meet all conditions liable to be met with in actual service. While the question of cost has not been lost sight of, more attention has been paid to secure completeness, reliability and good appearance than to keep down the cost to a minimum. Panels have been designed for direct-current plants, and for alternating, the latter ones being the subject of this paper, the boards being those made by the Westinghouse Company.

The type of switchboard shown in Fig. 1 is for 100-250 volts, and consists of polished marble panels placed side by side and supported on a suitable iron frame. The instruments, switches, etc., for the generator and feeder circuits are mounted on and form a part of these panels. In general these panels are intended for small installations and should not be used for plants having many multiple running generators. One panel should be installed for each generator and one for each set of feeders. Additional generators and feeders may be provided for at any time by adding the proper panels.

Blue Vermont marble, 1½ in. thick, ⅜-in. bevels, is standard, but panels are supplied of white Italian marble or black enamelled slate if desired. The framework consists of a piece of 3-in. x 2-in. x ¼-in. angle iron running the length of the board at the top of the panels, and a similar one at the bottom. A gas pipe leg at each end and one at every junction supports the marble 28⅜ in. from the floor line. The top angle iron, and, occasionally the bottom one, should be braced to the floor, the ceiling or the wall, and for small boards of five panels or less, where the bus-bars are not too heavy, this type of construction is entirely satisfactory. For boards of a greater number of panels or with heavy bus-bars a construction described later, should be used.

The controlling apparatus for an exciter consists of an exciter field rheostat and plug switches in the alternating-current circuit. When ammeters and voltmeters are wanted in the exciter circuits, it is necessary to provide exciter panels. The voltmeter is connected to the lines by means of a plug and receptacle, so that the voltage of any phase can be read. Knife switches with 250-volt spacing are used for these panels and at the time this line was laid out it was not intended to use these panels above that voltage. Since that time the Board of Fire Underwriters have authorized the use of these switches up to 440 volts alternating current, so that these panels can be used up to that voltage. These switches are described at some length farther on.



FIGS. 1 AND 2.—FRONT AND REAR VIEWS OF 100-250-VOLT SWITCHBOARD.

Both the alternating-current field and direct-current exciter rheostats are mounted on the back of the generator panels. The latter rheostat is placed inside the alternating-current rheostat frame and both are operated independently by concentric handwheels on the front of the board.

Fig. 2 is a rear view of this board and shows clearly the type of framework, the concentric rheostats for the generator and exciter, the shunt transformer with its fuse block and the plug switches in the field circuit of the alternating-current generators. It also shows the swinging bracket on which the voltmeter is mounted and the

method of locating the voltmeter resistance on this same bracket.

Fig. 3 is a diagram of connections for a board of this type and shows how the ground detector, voltmeter and synchronizer are connected. The ground detector consists essentially of a transformer with a three-point receptacle for three-phase work and a four-point for two-phase, with a plug, lamps and push button. If there is no ground on the circuit, the lamps will not light up, no matter in what receptacle the ground detector plug is placed. If there is a ground, the lamps will light up when the plug is placed in any receptacle except that one connected to the grounded leg.

The object of having the ground detector push button "double-contact," i. e., forming single-pole, double-throw switch is to allow the circuit to be normally closed across one phase by placing the ground plug in the receptacles marked with red fibre. This allows the lamps to be used for illuminating purposes, etc., as the push button is held by a spring in the closed position until it is desired to test for ground.

The diagram illustrates the method by which the voltmeter is connected across any phase and shows the connection for synchronizing. The instant of synchronism is indicated by the lamps being dark.

The two-phase generator panels have two ammeters, one in each phase, two two-pole switches or one four-pole, one combination rheostat, one voltmeter with six-point receptacle and plug and two

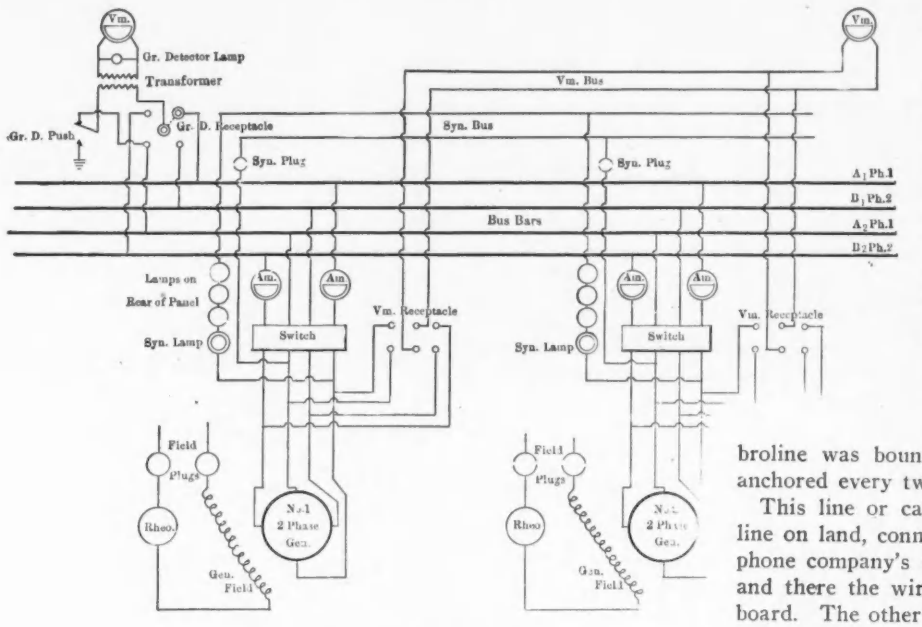


FIG. 3.—DIAGRAM OF CONNECTIONS.

field plugs. One type of panel has a synchronizing and ground detector outfit and is used for the first machine installed; a second type has the ground detector outfit omitted, and is used for the second and succeeding generators; a third type has the synchronizing outfit omitted and is used where there is only one machine and no additions are expected.

The two-phase feeder panels are built both with and without ammeters and as a rule two or more feeder switches are placed on a panel. Where ammeters are used, only one per feeder and not one per phase is the rule. The three-phase panels are similar to the two-phase except that the generator panels have three ammeters instead of two and both generator and feeder panels have three-pole switches.

It is a rule to recommend against the use of fuses or other automatic protection in generator circuits where the machines run in multiple. The reason for this is that generators of the sizes used with these boards should have sufficient armature reaction to prevent the current increasing to a dangerous amount, even on a dead short-circuit, so that fuses are not needed to protect the generators. At the instant of synchronizing two generators, if they are not exactly in step when thrown together, there will be a rather heavy flow of current from the leading to the lagging machine, which will pull the two machines together without damage to either. If there is a fuse or automatic circuit-breaker in the generator circuit it is very liable to blow at this time, making it necessary to replace the fuse or breaker and start again to synchronize.

Fuses, when ordered for the feeder circuits, are usually supplied for separate mounting, for on these panels there is rarely room enough for them to be mounted either on the front or on the rear.

This type of board is built with switches of 100, 200, 300, 400 and 600-amp. capacity, and, therefore, should not be used for larger machines than the following: Two-phase, 440 volts, 500 kw; three-phase, 440 volts, 450 kw; two-phase, 220 volts, 250 kw; three-phase, 220 volts, 225 kw.

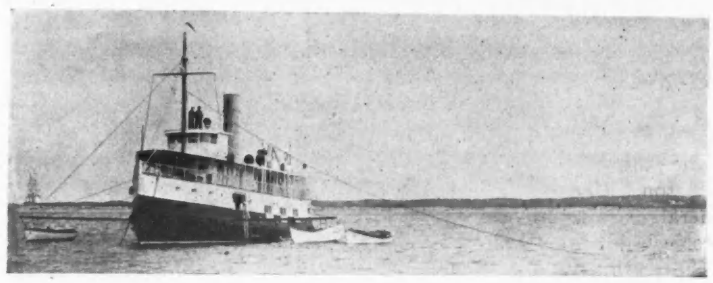
The above are limiting sizes and wherever possible for machines near the limit in size, panels of another type should be used as being mechanically stronger and being better arranged for heavy bus-bar work.

The Telephone at the International Yacht Races.

In connection with the recent yacht races an interesting application of the telephone has come to notice. The application in question was the equipping of the steamer *Sunbeam,* tender to the *Reliance,* with a complete set of telephone instruments, placing them in connection with the entire Bell system throughout the United States. As is well known, the mooring ground of the *Shamrock I* and *Shamrock III,* the *Reliance* and their tenders, was inside the Horseshoe at Sandy Hook. There each day the *Sunbeam* came to anchor during the races and for some time previously.

In order to place a telephone on the *Sunbeam* it was necessary for the New York & New Jersey Telephone Company to utilize their pole line running to the Hook, which carries the telephone line to the instruments leased by the government. From the last pole of the company additional temporary poles made of iron pipe were set upon the government dock to the nearest point from which the *Sunbeam* came to anchor. From the last pole an insulated pair of wires was run under the water to a temporary buoy placed by the telephone company. This pair of wires was covered with rubber and braid and served with hambroline to form an armor to resist the chafing of shells on the bottom of the bay. The hambroline was bound every sixteen inches and the cable thus made anchored every twenty feet with twenty-pound iron weights.

This line or cable was attached to a pair of wires on the pole line on land, connecting with a pair of wires extending to the telephone company's exchange at Atlantic Highlands, 14 miles distant, and there the wires terminated in a drop and jack in the switchboard. The other end of this twisted pair wire or cable terminated on a cork buoy in a detachable coupling placed in the vicinity of the point of anchorage of the *Sunbeam.* From the other side of the coupling a twisted pair wire was run (not served in this case, however, with hambroline) through a large sheave block rove to the masthead and extending to an ordinary set of telephone instruments



TELEPHONIC CONNECTION WITH TENDER "SUNBEAM."

placed on the steamer. Five hundred feet of slack was allowed for the swaying of the boat and the variation in its anchorage.

When the connection was made to the instrument on the steamer, communication was established with Atlantic Highlands exchange and thence through the entire telephone system, precisely similar to any other subscriber in the Atlantic Highlands exchange. When the *Sunbeam* left her moorings the coupling was opened, slack wire coiled on top of the boat's pilot house, the steamer then proceeding on her way. On the boat's return the coupling was united and telephonic communication established. In this way Mr. Iselin and his

guests on board the boat communicated with many New York and New Jersey points.

The accompanying engraving shows the tender *Sunbeam* just after the boat had come to anchor and the connection had been established to the temporary buoy. The pair of wires running from the masthead to the buoy and the buoy itself are plainly visible.

Overhead Pole Line Construction and Operation for Central Stations.*

By A. H. Manwaring and J. T. Hutchings.

WHEN the generation of electric current for light and power purposes had been commercially attained, and the necessary lamps and motors had reached a stage of development which promised successful operation, the problem of the distribution of the current claimed the attention of the electrical engineer. The presence of the large number of overhead telegraph lines served as a precedent and the central station distributing wires were, therefore, carried overhead on poles, and the line fittings patterned after existing telegraph construction. These fittings, however, failed to entirely meet the conditions of electric light distribution; and while some effort was made towards improvement, yet in the main the pole lines were greatly neglected. This was probably due to the expense involved, and also to the disposition of the station manager to concentrate his energies on the apparatus giving immediate trouble and his tendency to unconsciously postpone the improvement of the general construction until some opportune occasion, which unfortunately never presents itself.

The original construction was usually light and cheaply erected, and the lack of proper maintenance increased the number of accidents, which, together with the unsightly appearance of the poles, strongly agitated public opinion against the entire construction; and in many cities legislation was adopted to compel all wires for electric lighting purposes to be placed underground. On account of the limitations of the art, however, the installation of underground wires was not entirely successful. In recent years the improvements in construction have, in a large measure, overcome the original difficulties, and many lines which originally were overhead have been placed underground with entire success, especially in the more congested districts of large cities where the volume of business warranted the expense.

In suburban districts and small towns where a comparatively few consumers are scattered over a large territory, the cost of underground construction is prohibitive; and the cheaper pole line construction is the only alternative. For high-tension transmission lines carrying currents of 20,000 volts and over, pole line construction has been found the most feasible on account of the great distances covered and the cost of other forms of construction.

There is an impression existing among many engineers that an overhead pole line supplying electricity for light and power cannot furnish as satisfactory service as an underground system. While in many instances the results have, perhaps, justified their impression, yet it must be borne in mind that the most careful attention to all details is given to underground systems and no expense spared to make them satisfactory and reliable. If one-half the attention were paid to the details of overhead lines that is now given to underground lines, the system would be quite as satisfactory and reliable for continuous service to individual consumers as the underground system and much more cheaply maintained.

This paper treats of some of the important points to be considered in successful pole line construction for a plant supplying current for series arc lighting and alternating current for light and power; and refers especially to the methods in vogue in those sections of Philadelphia where business at the present time is not sufficient to warrant the installation of underground wires.

POLES AND CROSS ARMS.

The poles most frequently used are chestnut, Southern cedar, pine and iron. Chestnut poles when well seasoned are preferable for general line use, and are purchased to conform to the following specifications:

The poles must be straight, live white chestnut, having all bark removed and knots trimmed flush with the surface. The poles must not be less than 8½ in. in diameter at the top and have the following dimensions six feet from the butt: 35-ft. poles, 13 in. diameter; 40-ft. poles, 14 in. diameter; 45-ft. poles, 15 in. diameter; 50-ft. poles, 16 in. diameter; 55-ft. poles, 17 in. diameter; 60-ft. poles, 18 in. diameter.

The poles should be well shaved with a draw knife, except the part to enter the ground, which varies in length from 5 to 7 ft., as follows: 35 and 40-ft. poles, 5 ft.; 45 and 50-ft. poles, 6 ft.; 55 and 60-ft. poles, 7 ft.

Poles are roofed at the top to form a right angle. The poles are "gained" to form a flat of about 5 in. for the attachment of the cross arms, which are spaced 24 in. between centers, the top of the first arm being 1 ft. from the top of the pole.

All poles upon which are located devices requiring regular inspection, should be provided with steps in order to facilitate this work. The standard step is made of galvanized iron ½ in. diameter by 9 in. long, having 3 in. of thread. These are preferably placed 15 in. apart, the distance between two steps on the same side of the pole being 30 in., and the first step is placed 6 ft. from the ground.

Poles are spaced from 40 to 45 yards apart, depending on circumstances, and all end and corner poles are guyed with ¼-in. or ⅜-in. stranded galvanized wire. In long lines every tenth pole is also guyed, the wire being carried from the top of one pole to about 6 ft. from the base of the next. Poles are periodically inspected to determine if they are in good condition and perfectly safe.

Iron poles, generally speaking, should be avoided on account of the liability of shock to the linemen when working on live wires. The use of these poles, however, cannot always be dispensed with, and when used for street arc lighting, the lamp should be so arranged that it can be lowered and trimmed and from a stepladder, thus protecting the trimmer. If it is found necessary to suspend the lamp from a bracket attached directly to an iron pole, thus necessitating trimming from the pole itself, a portable grounding wire should be furnished which can be attached to the lamp, thus grounding the circuit and making it perfectly safe for the trimmer. This arrangement has been found to work very satisfactorily in actual service, although some trouble has been caused by the trimmer neglecting to remove the grounding wire after trimming the lamp. This, however, has been overcome by imposing a nominal fine for each and every offense. The safety of the trimmers is also considerably increased by grounding both wires of the circuit in the station during the time that the current is off.

Poles of Southern cedar lack mechanical strength, and pine is short-lived. These poles are, therefore, inferior to chestnut and should not be used when the latter is obtainable.

Junction poles in the past have caused considerable trouble, principally due to the manner in which branch lines at right angles to the main line were connected, and further, to the placing of fuse boxes on these poles. It is of the utmost importance that the wiring of junction poles should be made as simple as possible. Branch wires should be attached to reverse arms and the connections from the main to the branch circuit be made by vertical taps. Under these conditions the junction pole will be safe and accessible to linemen.

Cross arms should be made of selected yellow pine, free from knots and sap, finished on all four sides and having the upper corners chamfered, except where the arm bears against the pole. Cross arms should always be purchased unpainted in order to permit of rigid inspection, and immediately upon acceptance they should be covered with three coats of good white lead and oil. They should be attached to the poles with ⅝-in. through bolts with nuts and washers.

BRACES, PINS AND INSULATORS.

The braces are made of galvanized iron 28 in. long, 1¼ in. wide, 3/16 in. thick, having a hole 2 in. from each end, one 7/16 in. and the other 9/16 in. in diameter. Carriage bolts ⅜ in. x 4 in. are used for attaching the braces to the cross arms, and ½ in. x 4 in. lag screws for attaching them to the poles.

Locust pins 1½ in. x 9 in. well boiled in linseed oil are preferable for lines of 5,000 volts and under.

Double petticoat glass insulators are used for all series arc wires and secondary distributing wires. For alternating-current lines of 2,000 volts and over a special porcelain insulator is used in Philadelphia.

LIGHTNING ARRESTERS AND FUSE BOXES.

Lightning arresters are required primarily for the protection of transformers on the line and of apparatus in the station. The arrester installation for the station should be the best obtainable, and

* A paper read at the Thousand Islands Meeting of the Association of Edison Illuminating Companies.

should be so placed as to be under continual supervision by the switchboard attendant. With the exception of these no lightning arresters should be placed on the main line.

Each branch line should be protected with at least one set of lightning arresters, and in some instances several should be used, depending on the length of the branch line, location of the transformers, and the nature of the territory covered. All lightning arresters should be most carefully grounded, and it should be borne in mind that one set of arresters properly installed is superior to a number of arresters with poor ground connections.

Lightning arresters should not be directly protected by fuses, but they should be arranged with suitable devices to easily cut them out of circuit for inspection. This can be accomplished by the use of suitable fuse boxes having copper wire substituted in place of the fuses, or line switches having carrying capacities equal to that of the lines. After every heavy electrical storm, lightning arresters should be inspected to see that they are not damaged, and periodic inspections should be regularly made to see that the gaps are clear from dirt or dust.

The following are a few of the necessary requirements of a satisfactory fuse box on alternating-current circuits having voltages of from 2,200 to 2,500 volts:

1st. The fuse should be capable of opening the circuit under any and all conditions of short-circuit or overload.

2nd. The fuse box should be designed to prevent any leakage of current from the metal parts in circuit to the case of the box, under any and all conditions of weather. In fact, the insulation should be such that the box would operate with perfect satisfaction if mounted upon an iron cross arm.

3rd. The break distance should be sufficient to allow of the opening of the box under an inductive load of at least 30 amperes, without causing trouble.

4th. The box should be arranged to be easily and securely attached to standard cross arms in such a position as to be easily and safely opened for inspection and for the replacing of fuses.

5th. The box should be so arranged for the introduction of wires as to render contact with them unnecessary when the linemen open the box.

6th. The design should be such that when a fuse is replaced the lineman is in no danger of being burned by the arc or hot metal, or of receiving an electric shock.

At the present time there is no fuse box on the market that entirely meets all of these requirements, although several fulfil many of them. Fuses which were formerly perfectly satisfactory on 2,200-volt circuits, supplied by small generators, operated singly, will no longer break the circuit in case of short-circuit on the larger generators now generally used. When short-circuits occurred under the old system, the engines slowed down and the generator voltage dropped practically to zero, and almost any of the fuse devices on the market would open the circuit. At present large generating units frequently operate in parallel, and a fuse to be satisfactory should be capable of being blown directly across the bus-bars at the station without maintaining an arc. In Philadelphia we have instituted a rule to install no fuses of a greater capacity than 30 amperes on our alternating-current distributing lines. With a circuit-breaker at the station set for 125 amperes, these fuses will then open the branch circuit with little or no indication at the station.

The cut-outs protecting transformers should be so located as to be easily and safely reached for inspecting and replacing fuses.

The connecting wires to the fuse boxes should be insulated with at least 5/32-in. rubber, covered with a double saturated braid, and secured in such a manner that it is impossible for them to come in contact with other lines.

LOCATION AND INSTALLATION OF TRANSFORMERS.

Transformers should be attached to cross arms entirely independent of those carrying high-tension lines and should be so located as to be easily inspected. If the transformers are of large sizes, the arms to which they are attached should be reinforced in such manner as to insure their security under all conditions, and if necessary an additional arm should be placed below them to facilitate the climbing of the linemen to the upper part of the pole. Under no condition should the transformer be erected in such a position on the pole as to interfere with the regular work of the linemen.

LOCATION AND CONSTRUCTION OF TRUNK LINES.

The territory to be supplied should be divided into sections having as far as possible definite boundaries, both for series-arc and alternating-current circuits, in order that the power house, switchboard and line attendants and the office force also may be conversant with the exact district covered by each circuit.

The number of wires leading from the power house should be reduced to the least possible number. This can be best accomplished by increasing the size of the circuits and operating at high voltages. For this reason and also for the betterment of the service, all 1,000-volt alternating-current circuits should be increased to 1,100 volts, and series arc circuits to 125 lights each. With such a system the number of wires leading from any station can be kept within satisfactory limits. There should be, however, not less than two main trunk lines leading from the power house, and these should be run in as direct a line as possible to the centers of the various sections. However, care should be exercised that these lines are run in streets having the least number of telegraph and telephone wires, and also where they will be least objectionable to the public. In fact, it is preferable to increase the length of a line 1,000, or even 2,000 ft., than to select a more direct route at the expense of public good will.

Series circuits for both arc and incandescent street lighting should, as far as possible, be laid out in compact blocks, and so arranged that with the exception of the main lines there will be but one line on a street; in other words, a circuit should run out on one street and return on another.

Each series-arc circuit of 125 lamps should be subdivided into at least three loops, so arranged that any one can be separately cut out by a switch. This will be found of great assistance in locating open circuits and grounds; and in case of fire the section affected can be easily and safely cut out without interfering with the rest of the circuit.

All wires on the main or trunk lines should be well drawn up in order to prevent crosses. All series circuits from the power house to the point where the circuit branches, should be carried on pins occupying the same relative positions counting from the top of the pole. This would also apply to alternating-current circuits, unless the distances covered are such as to require transposition. No cut-out boxes, transformers or lightning arresters should be erected upon the main or trunk lines as previously mentioned. The wires for the circuits which first branch off from the main line should be carried on the lower cross arms, and wires supplying the more distant sections should be carried above; the reason being that wires which require least attention should be placed out of the way of the linemen, whose services are generally most needed on those wires which supply the business in the immediate neighborhood.

Where series-arc or series-incandescent lines for street lighting are erected on the same poles with alternating-current lines they should be carried below the latter since they are out of circuit during the day; in other words, all high-tension lines which are in circuit continuously, should be located on the top cross arms, thus obviating the necessity of linemen when working on the series lines from coming in contact with them. For the same reason the secondary lines being safely handled, should preferably be placed on the lower arms. Secondary wires should not be attached to the same cross arms with high-tension lines, unless on opposite sides of the pole.

It is advantageous to erect alternating-current lines which are in circuit 24 hours daily, on a distinct type of insulator, in order that linemen will know at a glance what circuits are alive. This can readily be accomplished by using porcelain insulators for alternating-current and glass insulators for series circuits, the latter being in use only at night. This is also of assistance in tracing out the circuits.

All branch circuits should lead from reverse arms, except in the case of single series-arc loops, which may be attached to an iron break arm on the outside or end pin. If alternating-current branch circuits lead in both directions at cross streets, the wires should be carried straight across and a common connection made to the main line.

The necessary fuse boxes to protect the mains should be placed on the first pole each side of the trunk line.

Where numerous telephone or telegraph wires cross above electric light wires, a separate six-pin cross arm should be attached at the top of the pole for supporting two No. 10 galvanized iron wires (one at each end of the cross arm) stretched from pole to pole as guard wires.

GROUNDING OF SECONDARIES.

All secondary mains supplied by transformers should have the neutral wire of the three-wire system or one wire of the two-wire system grounded. It is also necessary that a suitable ground be furnished at the premises of each consumer, in addition to the

regular installed grounds upon the system. In case of a number of transformers being connected in multiple there should be a ground for each transformer.

It might be mentioned incidentally that in connecting two-wire meters the field coils of the meter must not be connected to the grounded side of the system, as otherwise there may be a loss of revenue, due to the meter being shunted by grounds in the building, etc. When conducting a periodic test of the meters, the condition of the ground connections in the building should be examined and repaired if defective.

We have found it quite advantageous to have certain of the regular day force of linemen detailed alternately to look after the complaints at night. Each man naturally gives more attention to the character of his work when he appreciates that his duties when on the night shift are more or less arduous in proportion to the manner in which he and his companions have performed their work during the day.

RULES.

If the plant is of sufficient size to require division into sections or districts for successful operation, a uniform system of rules and diagrams should be used in order that all work of the same character shall be performed in a uniform manner. This enables a lineman to be transferred from one division to another, and still be perfectly familiar with his work.

The following are a few of the general rules to line foremen:

1. No wire of smaller size than No. 6 B. & S. gauge shall be used for either primary or secondary work.

2. All alternating-current primary line wire shall be erected on porcelain insulators upon adjacent pins.

3. All arc line wire shall be erected on double petticoat glass insulators.

4. Alternating-current and arc line wires shall in no case be placed upon the same cross arm unless the pole is between.

5. All joints shall be well soldered and taped.

6. Secondary lines shall at all points be at least 18 in. from primary or arc lines unless covered with heavy porcelain tubes.

7. Fuse boxes shall be placed upon all branch circuits.

8. The main circuits shall not be fused as long as the wires are maintained of the same size as at the station.

9. Fuse boxes for branch circuits shall in all cases be fused 25 per cent. smaller than the main fuse at switchboard; and in no case shall branch fuse boxes be fused with copper wire.

10. Fuse boxes for branch circuits shall be placed upon the first pole from the junction pole.

11. Transformers shall not be placed on the exterior of buildings, sheds or other property belonging to the consumer.

12. All poles having transformers or fuse boxes upon them shall be stepped.

13. No fuse box or transformer shall be placed upon a junction pole or lamp pole, except where absolutely necessary, in which case the office shall be notified and permission obtained.

14. Transformer poles shall in all cases have full six-pin arms.

15. In placing transformers for motors, 1 kw should be allowed for each horse-power up to 30 hp, except where a number of motors are installed upon one group of transformers, in which case the capacity may be reduced in accordance with the condition of load.

16. All consumers having 200 lights or over, who are not regular in their hours of burning, such as churches, lodge rooms, public halls, etc., shall be placed upon two-phase wherever possible.

17. In connecting two-wire consumers upon three-wire secondary circuits, care should be taken that the load is evenly balanced, as to location and time of burning.

18. Wherever practicable, consumers should be grouped upon one transformer, or system of transformers and secondary wires.

19. The object in grounding a secondary wire of transformers is to prevent high-tension current from reaching the secondary wires. The neutral wire of all three-wire secondary circuits must be grounded, and also one side of all two-wire secondary circuits.

20. It is of the utmost importance that the primary fuses protecting each transformer shall be of a size proportionate to the capacity of the transformer. When a transformer is fused excessively heavy, or with fuses of dissimilar sizes, one fuse only is liable to blow, thus leaving current on the defective transformer.

21. It is essential that, when a primary fuse on the transformer is blown through any cause, the secondaries should be disconnected from the transformer and the latter tested to full line voltage between the primary and secondary coils, so as to determine that there is no breakdown in the insulation between these coils.

22. All alternating-current circuits should be tested daily for grounds.

23. All series lighting circuits should be tested for grounds within ten minutes after the circuits are taken off, and for open circuits, crosses and grounds at 12:10 P. M. and 3:10 P. M., and also one hour before starting time.

Throughout the country are hundreds of localities and small towns which would be deprived of the advantages of electric light and power, were overhead lines abolished and all wires compelled by law to be placed underground. The cost of the latter system, as previously mentioned, is often prohibitive and the cheaper pole line construction is, therefore, a necessity and will maintain its supremacy in many districts for years to come.

It should be the duty of every station manager to see that all work on overhead lines is performed in a permanent manner, whether erected for continuous or temporary service. Temporary repairs must of necessity be made if trouble is located and cleared at night or during stormy weather, but these temporary repairs should be reported and become the first work on the following day.

The station manager is, no doubt, frequently tempted to use the cheaper telephone and telegraph construction for light and power purposes, especially when appropriations are inadequate for thoroughly substantial work. He should, however, refuse to employ such construction under all conditions, and should be as particular and as firm in rejecting such material as he would be in refusing to employ light tubing for high-pressure steam lines.

The station manager must appreciate that the vital point in overhead construction and operation is attention to details, and if he will see that all work is erected in a thoroughly permanent manner, he will accomplish much towards the prevention of complaints from the general public and from the consumers of his own company.

Purchased Electric Power in Factories.*

By E. W. Lloyd.

The growth of electric power loads in central stations during the past ten years has been no less than marvellous. There is scarcely a member of this association who does not remember the time when the installation of a ten horse-power motor on the Edison system was an event known to every employee of the company, and commented upon fully as much as the connecting of a five hundred horse-power installation at the present time. There is scarcely a doubt but that the connected central station power load in large cities will equal the connected light load at a very early day, as the removal of large isolated plants in office buildings and mercantile houses has increased our power loads with leaps and bounds. The time has come, however, when we must look to large individual motor installations in factories if our present rate of growth is to be maintained.

The small power customer in large cities comes with little or no solicitation, and need not be considered here. It is of the installation of motors, and the cost of power from central stations for large factories, in comparison with isolated plant costs, that this paper will endeavor to treat.

It seems to be the policy of some companies to offer power rates at almost the cost of production, and in some cases, to go even lower in order to build up a day load.

The experience of one company demonstrates that in a great number of cases factory plant costs per kw-hour were much in excess of what we now sell them current for at a profit.

Low power rates are a detriment to central station business, as these rates are published by customers from place to place, and often business is lost because the prospective customer hears of an extremely low price in another city, where the local conditions, or more often the anxiety of the company to get a power load, prompt them to give a low rate without learning what it actually costs to operate the isolated plant. Before giving a prospective customer a price per kw-hour, it is well to know what his factory plant costs are. In ascertaining these costs you will probably meet with difficulties. The manufacturer with engineering training, or having a mechanical or electrical engineer as manager, thinks he can generate power just as cheaply as we can sell it. We find, however, that a large portion of the customers with whom we ultimately do business, know little of their actual plant costs, and if their estimate of costs is taken, we

* Abstract of paper read before the Association of Edison Illuminating Companies, Thousand Islands, N. Y., Sept. 8-11, 1903.

would find a cost per kw-hour with which it would be impossible for us to compete. A careful investigation of the plant will determine whether their figures are correct. If their system of keeping costs is wrong, it is necessary that the information be estimated from data obtained by going over every detail of the driving machinery, plenty of allowance being made for large coal consumption when the apparatus is over five years old.

An important point is the examination of all the pumping machinery. It has been our experience that the steam pump is one of our best friends. Frequently the decision as to whether a plant be operated from central station service, or an isolated plant be installed, is determined by the large steam consumption of the pumps per horse-power per hour.

The items enumerated below are those which should be considered in making up the total cost of operating an isolated plant:

Salary of engineers; salary of firemen; salary of electrician; fuel; removal of ashes; water; oil; repairs to boilers; repairs to engines and dynamos; lamps; carbons; tool account; miscellaneous expense and supplies, waste, packing, etc.; general expense; depreciation; interest on investment; insurance; rental value of space; damage resulting from heat and vibration; risk to employees and the public through accidents and boiler explosions; taxes.

In addition to the above plant costs it is often necessary to add the following: Maintenance of rope or belt transmission lines; unnecessary investment in shafting and hangers; salary of millwrights.

Our experience has been that it will generally be necessary to estimate most of the above items, as the customer has not kept these costs separate from other similar accounts. Such items as salaries, supplies, coal and water, are about the only ones that can be accurately obtained over a period of years.

In estimating the kw-hour output of an isolated plant, we have to take into consideration not only the power consumed by the machines themselves, but the friction load of the heavy transmission shafting, and the wastes in the generating machinery. It is also essential that we be familiar with the customers' output, and have a knowledge of the workings of different kinds of machinery, and know the power required to drive each machine, together with the number of hours per day each runs. An estimate made on this basis can be checked by indicator cards taken every fifteen minutes during the day for several days. A one-day test is, as a rule, very inaccurate, as the machinery varies in its operation from day to day. These tests are necessary only in large factories, as a proper estimate of the kw-hour consumption may be made of a small installation without this expense.

Engine tests are very often deceiving, it being extremely difficult to separate the friction load present in all engine-driven plants from the actual power delivered to the machines. It is therefore, much more accurate to estimate the kw-hour consumption for each machine or group of machines. These estimates can be made quite accurately by an engineer who is trained to the work.

Instances have come to my notice of cases where there was under 5 per cent. variance between the bills and the estimate. Having the plant costs and the kw-hour output of the plant, their kw-hour rate can be compared with the central station rates with gratifying results.

In addition to the favorable comparison of rates, we have the advantage afforded by the lower kilowatt consumption of the machinery after the removal of waste caused by the constant running of generating machinery, shafting, steam pumps, pulleys, belts, etc. These changes in most cases turn the tide in our favor, as, in the majority of factories, the percentage of lost energy is very large.

One of the most difficult tasks we have is convincing a customer that his average load is not equivalent to his connected load, nor is his maximum load the average. It is surprising what a large number of people there are who persist in these views. When a customer is asked how much power he will require, he invariably mentions the horse-power of his engine, and when you give him a rate per kw-hour immediately proceeds to multiply this by his hours of running and finds an enormous cost per month.

Besides the ordinary causes of waste above mentioned, there are generally numerous changes that can be made in plants, which will reduce the current consumption materially. If air is used for hoisting and drilling, these machines can be replaced with electric hoists and motor-driven drills. Of course, if the plant uses hammers or riveters, the air compressors cannot be removed, but they can be changed to motor drive with an automatic controlling device arranged to start and stop the compressor, as the conditions of operation require. Where it is necessary to have shafting of any length, a saving on the friction load can be effected by the use of light line shafting and three-point bearings.

In order to substantiate the argument that central station charges are cheaper, the table given below shows costs per month taken from a customers' books for one year previous to the removal of their plant, that are higher than their present current bills from us:

Salary of engineer, $90; salary of fireman, $60; fuel, $577; removal of ashes, $8; water, $20; oil, $2; repairs $15; tool account $2; miscellaneous expense supplies, $15; depreciation, $83; interest on investment, $49; insurance, $6; rent value of space, $25; interest on unnecessary investment in shafting, $5; total, $956.

This customer is running about the most difficult class of machinery to which we are called upon to supply power. They carry on a structural steel business operating punches, shears, traveling cranes, a fully equipped machine shop, carpenter and pattern shop, foundry, a 75-hp beam saw, and a 75-hp air compressor, having a total of 400 horse-power in motors. With a 4c. rate per kw-hour running ten hours a day, their bills run about $800 per month. We expect to run them for considerably less money by replacing a number of their air hoists by electric, as their air hoists takes about five times the energy after all wastes are calculated.

The only way we were able to save this firm money was by the elimination of all wastes throughout the plant. Most of the machines have a motor directly connected to them, the exception being the carpenter and machine shops, which are group driven.

These facts demonstrate that proper motor installation is the large factor in reducing the cost of power from central station service. I do not believe it is necessary to follow the advice of some manufacturers of motors in order to have an efficient installation, such as specifying the very large motors necessary for multiple voltage control, where the motor in some cases is 50 to 75 per cent. larger than need be; but on such machines as pumps, air compressors, punches, large machine tools, large wood-working machines, beam saws, hoists, printing presses and the like, it is essential that a motor be installed for each in order that the average load be as small as possible.

The two voltages supplied by the Edison three-wire system, together with the use of any of the numerous mechanical methods of speed changing, will efficiently supply all the range in speed required by any tool with which I am acquainted.

The first cost of a motor installation often militates against us when figuring with a prospective customer for current, but this prejudice is rapidly disappearing as the numerous advantages in favor of motor drive are becoming widely known, and up-to-date factory managers are making changes whether they use central station current or generate their own.

I believe it good policy to be extremely liberal when quoting costs to install motors, as their sale is really a secondary consideration in connection with central station business. Spread the payments for motors over long periods, with good allowance in case they be taken back. Make a guarantee on the bills per connected horse-power per month for a short period; in fact, force the customer to do business when the negotiations get to a point where you are apt to lose him.

I do not mean to take the position that it is necessary to cut rates in order to close a contract, because making a stipulated price per horse-power per month does not make the rate. Keep up your rates, but use every possible expedient to get power business by a liberal policy. Some people are afraid of central station charges, and it is necessary to make concessions to sufficiently interest them to make the trial.

In figuring on motors with our customers, we frequently find that we are underbid very materially by makers of inferior apparatus, and the customer is inclined to buy the cheaper machine on account of the saving in the first cost. This is frequently very poor policy on his part, we find there are often machines which are defective in design and therefore take more current than they should. It is sometimes hard, however, to convince a customer that a slight difference of efficiency makes any particular difference. We have figured out the difference in the Edison bills which would be made by a difference of efficiency, from 1 per cent. to 10 per cent., in order that the customer may see in dollars and cents what it means to him on a year's bills.

By studying the table it will be readily seen that a slight disadvantage in efficiency will make what appears to be a cheap motor by

far the most expensive in the long run; *e. g.*, assume two motors of 10-hp capacity each, one selling at $250 and the other at $225. Let us assume that the motor will average 3 horse-power ten hours a day the year around. Assume that the average efficiency of the cheaper motor is 3 per cent. less than that of the $250 one. The annual cost for current would be $20.94 greater. Capitalizing this annual difference on the basis of 5 per cent., we find that the cheaper motor costs $225 plus $104.70, or $329.70 as compared with the $250 machine.

The following table shows annual variation in cost of current caused by variation in percentage of efficiency. Table based on motor running at full load ten hours per day for 312 days. Current based on 5c. per kw-hour. When the hours running per day of motors is determined, the actual loss can be easily figured:

PER CENT. VARIATION IN EFFICIENCY.

H.P.	1 per cent.	2 per cent.	3 per cent.	4 per cent.	5 per cent.	6 per cent.	7 per cent.	8 per cent.	9 per cent.	10 per cent.
1	1.17	2.27	3.49	4.65	5.83	6.91	8.15	9.32	10.48	11.67
2	2.32	4.65	6.98	9.30	11.65	13.93	16.31	18.64	21.00	23.00
3	3.49	7.90	10.47	13.95	17.60	20.92	24.50	28.00	31.40	34.50
5	5.82	11.73	17.45	22.75	29.25	34.50	41.00	46.50	52.00	58.00
7½	8.74	16.50	26.15	34.00	44.00	53.00	61.00	70.00	78.50	87.00
10	11.65	23.15	34.90	46.50	58.25	69.50	81.50	93.00	104.50	116.50
15	17.48	35.00	52.00	62.00	88.00	104.00	122.50	140.00	156.00	174.50
20	23.30	46.50	70.00	83.00	116.50	139.50	163.00	186.00	208.00	233.00
25	29.00	58.00	87.00	104.00	146.50	174.00	204.00	232.50	260.00	290.00
30	35.00	70.00	104.00	124.50	176.00	209.00	245.00	280.00	314.00	350.00
35	40.75	86.50	126.50	145.00	205.00	243.00	286.00	326.00	365,00	407.50
40	46.60	93.00	139.00	165.00	235.00	278.00	325.50	374.00	417.50	466.00
50	58.25	117.50	174.00	207.50	279.00	348.00	412.50	467.50	500.00	582.50

My company makes a practice of buying plants, and often the difference between the salvage allowed and the cost of the motor installation is very small.

When there is a plant to be removed we find it to our interest to offer good prices for the second-hand machinery. Often a customer is agreeably surprised at what is offered for his plant and will sign a contract at good figures where he would become dissatisfied and refuse were we to appraise his plant too low. We find a good market for all the apparatus we remove at very good prices, and there is no doubt about the value of the second-hand machinery department. We have a gang of expert wreckers who place the machinery in the warehouse in good shape, where it is cleaned up and put in presentable condition for sale. A few well-placed advertisements in trade papers bring plenty of inquiries, and we rarely carry any of the machinery over a year.

Besides the removal of wastes in plants above enumerated, there are other savings which should receive consideration in case the factory where motors are to be installed in a new building. Such as, less investment in line shafting, smaller foundations for the building, lighter roof supports owing to the decreased weight of the shafting and the absence of belts, which allows of the installation of traveling cranes, thereby increasing the handling facilities of the factory, and reducing the cost of the output.

There are also a great many reasons in addition to the actual cost of current, why central station service should be used, and before presenting our estimate it is always a wise precaution to bring these points to the attention of a customer. Following are a few of the reasons: Constant smoking, causing the manufacturer annoyance and trouble with the city authorities, who force him to use a high grade of smokeless coal at great cost, or the installation of costly smoke consumers or furnaces. Strikes of engineers, firemen or teamsters; inability to get coal; break-down of transmission shafting, belts, engines or boiler plant, together with the liability of accident in operating a plant where trouble is being had with the employees. Also the large losses suffered by the manufacturer when accidents occur causing the closing of the whole factory. With reference to accidents: We have a customer who had been operating a plant for the supply of power and light for twenty years. One night about six o'clock the battery of boilers burst, killing nine people and maiming many others. They called on us for temporary service, which we were able to give them by 7.30 next morning, having a construction gang of sixty-five men working all night. After running them temporarily for a time, an estimate was made for permanent service, with the result that they are now on our system. Their losses, including claims exceeded the total cost of the operation of the plant for over ten years. It is needless to say that they will not install a new plant.

Further advantages are the reliability of the service from the central station at any time during the twenty-four hours, with possibility of running any one tool or group of tools if necessary, without starting a large engine and paying a night engineer and fireman; the privilege of using two voltages from the three-wire system, insuring large speed variation, especially for individual motors, and a corresponding increase in the output of the plant. Flexibility of the motor installation, allowing an increase in the motive power at very little cost with the additional advantage of a better rate the more power used. Furthermore, the increased cleanliness in the factory; the absence of belts, vibrations, heat, and the increased output (which is a very important point) due to the absence of belt slippage.

I have tried to bring out the point that proper motor installation is the important one to consider when figuring on new business. I wish to emphasize this by saying that it is far better to refuse business when the customer refuses to install motors in accordance with the best engineering practice, as a customer invariably fails to renew his contract when he finds his bills running a great deal higher than he expected. In addition, he publishes his high costs and stops many prospective customers by his talk of robbery by the Edison Company.

It is safe to say generally that we can handle economically any business when the average load does not exceed 35 per cent. of the connected load. In one large plant an installation of 2,800 connected horse-power in individual motors is driven by a 500-kw generator, the average power required being but 15 per cent. of the connected load.

I believe we are just entering the power field, and that in a very few years the furnishing of power from central station service will be quite as important as the distribution of light. The recent developments in steam turbines and high-class generators, promise to open up a vast field for power and light stations. There is no reason why central station power cannot be sold cheaper than it can be made by any isolated plant, and our experience is grounding us more firmly in this belief every day, as we only recently took out the largest isolated plant in the city of Chicago, which approximated 8,000 horsepower, and connected the business to our system, saving them money, and giving them better service than they ever had from their own plant.

Altogether, we have removed over fifty isolated plants in Chicago during the past three years, and connected them to our system.

The removal of the isolated power plant is a natural evolution, and the supply of power from central stations is merely another example of the consolidation of all interests both from a business and an engineering standpoint.

The solution of the smoke problem, and freedom from labor troubles, lies in the furnishing of power from central station service.

Boys on Radium.

One of the most interesting lectures delivered at the meeting of the British Association, which was recently held at Southport, was by Mr. Vernon Boys, president of the mathematics and physics section, relative to radium. Mr. Boys suggested a connection between radioactivity, as now observed, and the stock marvel of the comet and its tail. "What is a comet and of what does its tail consist?" asked Mr. Boys. It was impossible not to be struck by the similarity of the language used in describing comets and that used in any paper written on radium. He knew that mere superficial similarity was worth very little, if anything, but for centuries the sky had shown us phenomena still not entirely understood, and inability to remove all difficulty by the aid of radium or similar material was no reason for dismissing the idea of any connection without further thought. He added that Sir William Crookes has devised an experiment in which a particle of radium keeps a screen bombarded forever, so it seems, each collision producing a microscopic flash of dancing light, the multitude of which forcibly compels the imagination to follow the reasoning faculties and realize the existence of atomic tumult. Radium in some respects, he said, behaved in a manner contrary to that of all proper chemical thorium or uranium, which acted in the same kind of way as did radium, but with far less vigor, and would last a million years before there was nothing left, or at least before they were worn out, while radium, preferring a short life and a merry one, could not expect to exist for more than a few thousand years. In that time one gram of radium would evolve one thousand million heat units, sufficient, if converted into work, to raise 500 tons a mile high, whereas a gram of hydrogen, our best fuel, burned in oxygen, yielded only 34,000 heat units, or one thirty-thousandth part of the output of radium.

An Object Lesson in Telephone Receivers.—II.

BY ARTHUR V. ABBOTT, C. E.

THE STROMBERG-CARLSON RECEIVER.

THIS receiver is a highly developed instrument and of great interest and value in the study of receiver design. The assembled receiver is shown in Fig. 42 and a sectional view in Fig. 43. In Fig. 44 the magnetic system is removed from its case, while in Fig. 48 the receiver is completely dissected into its component parts. The case shown at *A* in Figs. 43, 44 and 45 is composed of a

FIG. 42.—RECEIVER ASSEMBLED.

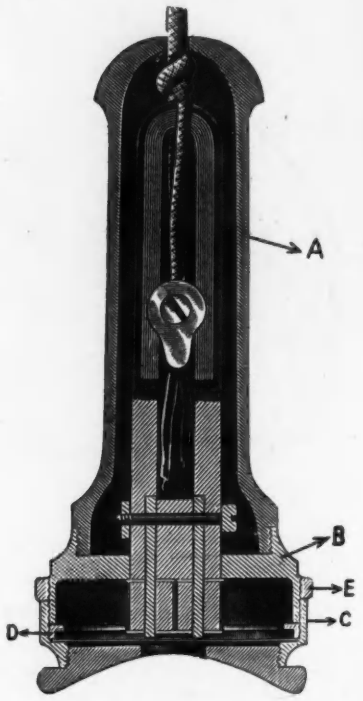


FIG. 43.—SECTIONAL VIEW OF RECEIVER.

single piece of hard rubber, on one end of which a screw thread is cut, while at the rear the case is reinforced and the cord passes through a hole in the center to reach the terminals of the line coils. On the front end of the case a brass cap, *B*, is secured by means of a screw thread. This brass cap is made very solid and substantial and carries in its center a projection, *X* (Fig. 45), to which the pole pieces and magnetic system are bolted as shown in Fig. 43, by

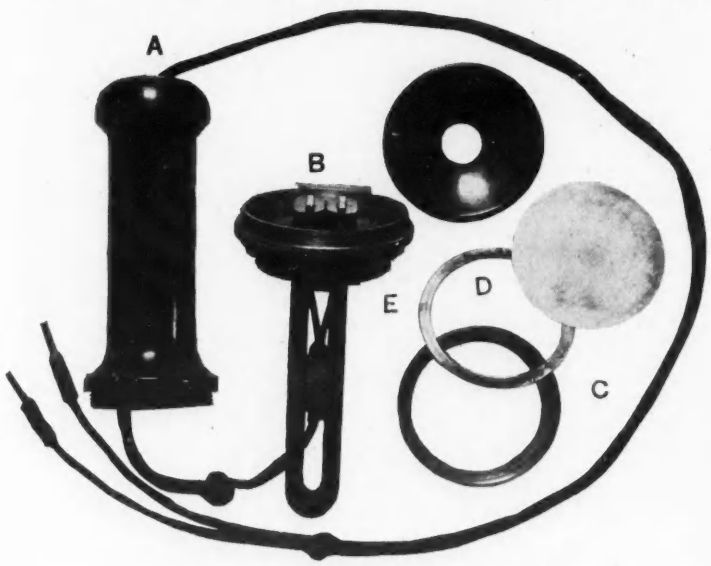


FIG. 44.—RECEIVER PARTLY DISSECTED.

means of a bolt which passes directly through both of the poles and the projection upon the brass cap, so that this cap forms a solid foundation for the whole instrument to which the magnetic system is secured in the strongest manner. On the outside this brass cap is threaded and a circular brass ring, *C*, is cut to engage with this thread. The diaphragm is placed on the inside of this ring and

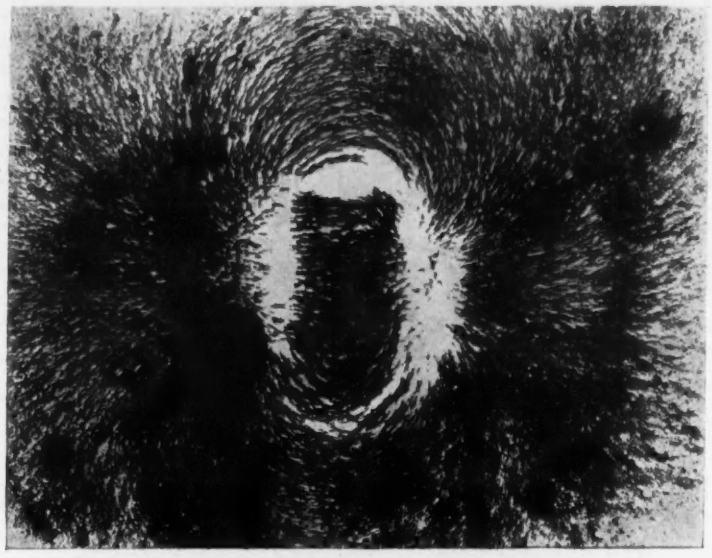


FIG. 46.—PHANTOM WITH DIAPHRAGM REMOVED.

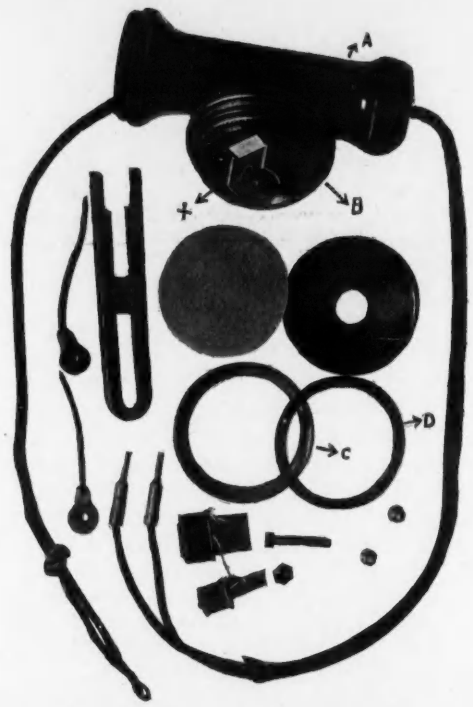


FIG. 45.—RECEIVER COMPLETELY DISSECTED.

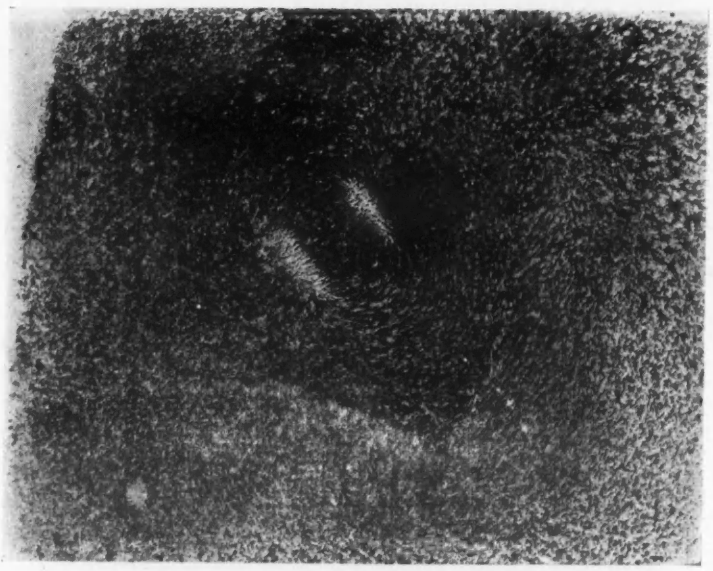


FIG. 47.—PHANTOM WITH DIAPHRAGM IN NORMAL POSITION.

secured against a shoulder by means of a follower ring, *D*, which is threaded into the inside of the cap, *C*. By this means the diaphragm is clamped very firmly between two sharp circular brass rims, and it is evident that as the ring, *C*, is threaded on the exterior of the brass cap, *B*, the adjustment of the diaphragm with reference to the pole pieces can be made with the utmost nicety and exactness. Finally, in order to secure the cap, *C*, in its place, a follower ring, *E*, which acts as a lock nut, is screwed up against the cap when it is in

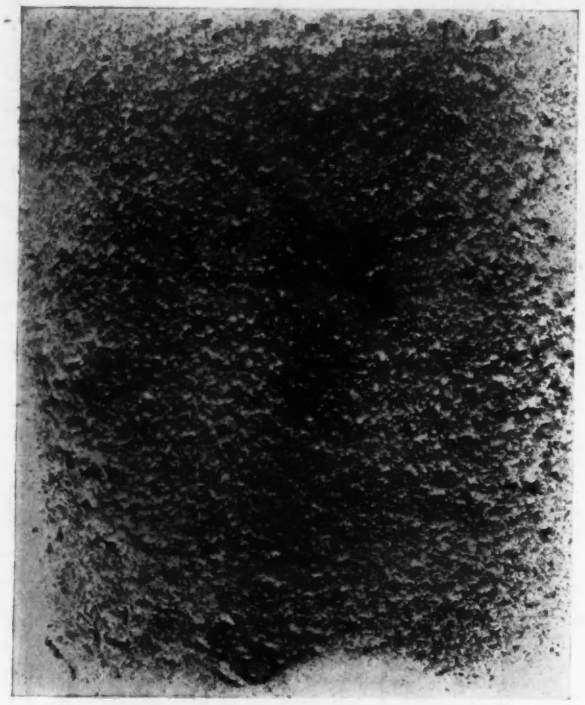


FIG. 48.—PHANTOM WITH DIAPHRAGM 1/8 IN. FROM POLE-PIECE.

its final position. The diaphragm is of sheet iron tinned .01 in. thick, 2.19 in. in diameter over all with a free diameter of 2.12 in. The magnetic system consists of one U-shaped bar of steel .625 in. wide and .24 in. thick, with its outside edges slightly chamfered. There is a distance of .35 in. between the sides of the U, while the magnet is 4.60 in. in length. The pole pieces are of soft iron .590 in. wide, .10 in. thick and 1.18 in. long. The coil spools are of fibre .44 in. wide, .860 in. long and .50 in. deep. The winding of the local battery instruments is of No. 38 wire, having a resistance of from 90 to 100 ohms, with about 1,200 turns, the line coils being connected in series. The tractive effort is 2.940 pounds (1,332 grams). This corresponds with tractive effort per sq. cm. of 1,755 grams, giving an induction in the pole pieces of 13,100 gausses, corresponding to a remanance in the permanent magnet of 5,800 gausses. The receiver cord passes through a hole in the rear of the case. On the inside a large and heavy knot is tied in the cord, which forms a very flexible stop, and prevents the weight of the receiver from producing

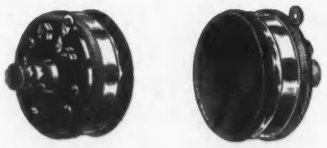


FIG. 49.—WATCH CASE RECEIVER.

FIG. 50.—WATCH CASE RECEIVER WITH HEAD BAND.

any strain upon the terminals. Between the faces of the magnet a fibre block is placed to which the line wire terminals are carried by means of two pieces of okonite wire that pass through the cap, *B*. These terminal wires carry two brass terminal pieces that are secured to the fibre block by means of screws, to which the cord tinsel is connected. This receiver is very substantial and will bear a great amount of abuse without injury to any of its parts. Figs. 46, 47 and 48 are phantoms from this model. Fig. 46 is the phantom with the diaphragm removed, exhibiting plainly a most powerful field. Fig. 47 is the phantom with the diaphragm in place, showing that in this receiver the diaphragm is fully saturated, while Fig. 48 is a phantom taken with the diaphragm removed 1/8 in. away from the pole pieces, and strikingly illustrates the effect of changing the adjustment of the diaphragms with reference to the pole pieces, for in this phantom there is hardly a trace of magnetism exterior to the diaphragm itself.

Figs. 49 and 50 illustrate the Stromberg-Carlson watch case receiver. In general design this receiver adopts as far as practical

FIG. 51.—RECEIVER DISSECTED.

the model and the principles in the hand telephone, departing therefrom only in so far as necessary to secure the requisite lightness to enable the receiver to be worn upon the head. In Fig. 50 the assembled receiver includes a band, whereby it may be supported from the head, is shown.

THE AMERICAN RECEIVER.

The American receiver exhibits another method of securing an adjustment between the pole pieces and the diaphragm. Fig. 51

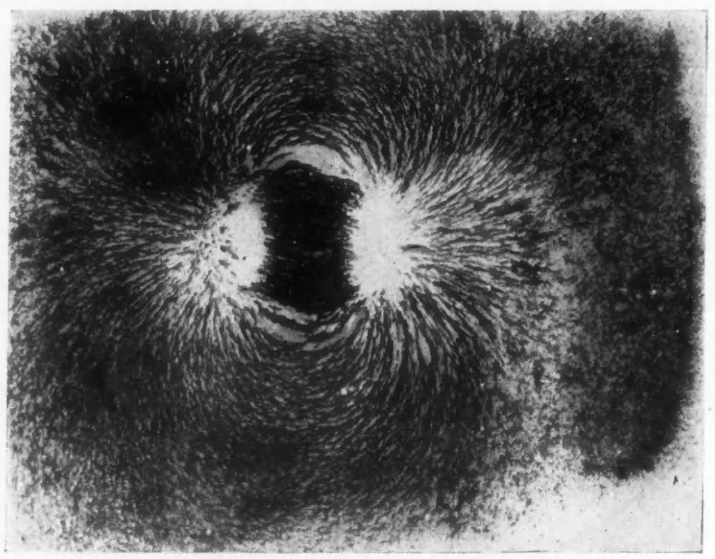


FIG. 52.—PHANTOM OF RECEIVER WITH DIAPHRAGM REMOVED.

shows this receiver dissected. The case consists of two pieces of composition. Upon the front the diaphragm cap is threaded, while the receiver cord passes through a hole in the rear. The magnetic system consists of a U bar .655 in. wide, .25 in. thick and 4.25 in. long, the U being formed so that there is .32 in. between the parallel phases. The pole pieces are .61 in. wide, .10 in. thick and 1.5 in. long, and are recessed in the top of the U bar. Before the pole

pieces are put in place a wash dish-shaped piece of brass is set under the pole pieces and on top of the U. This wash dish piece is pressed in a die and after it is in position the face of the dish and the face of the pole pieces are grounded on a lap so as to be exactly in line. The diaphragm is of sheet iron tinned and as is shown in Fig. 51 is dished, the dishing being sufficient to carry the center of the diaphragm about .03 in. away from the pole pieces. The edge of the diaphragm rests upon the face of the brass dish that is secured between the pole pieces and the magnet. The receiver is assembled by slipping the magnet placing the diaphragm on the piece of the

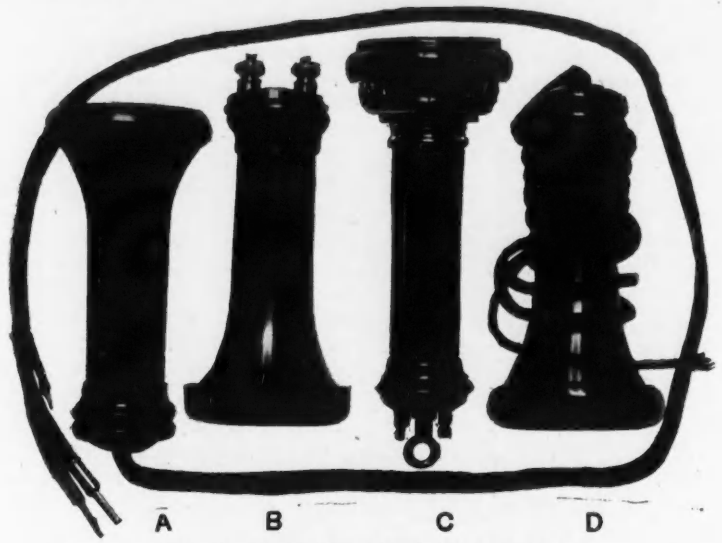


FIG. 53.—DIFFERENT TYPES OF RECEIVERS.

A—KELLOGG RECEIVER. B—MANHATTAN RECEIVER. C—ERICSSON RECEIVER D—WESTERN TELEPHONE COMPANY RECEIVER.

dish, and clamping the whole with the diaphragm cap. It is evident from this mode of construction that there is no means of making any adjustment of the distance between the diaphragm and the pole pieces after the process of manufacture is once completed. The

FIG. 54.—A—KELLOGG RECEIVER DISSECTED. B—MANHATTAN WATCH CASE RECEIVER ASSEMBLED.

receiver cord enters the instrument through a hole in the rear of the case and is then knotted after the fashion of the Stromberg-Carlson model. The terminals pass to a block placed between the parallel faces of the magnet and are there connected to the leading-in wires. From this block the leading-in wires of heavy copper pass through holes drilled in the brass dish to the line spools. The line spools are made of brass .40 in. wide, .90 in. long and .62 in. deep. The winding is of No. 36 wire and the resistance about 125 ohms. The tractive effort is 2.170 pounds (964 grams). This corresponds to a tractive effort of 1,240 grams per sq. cm., indicating an inductance of 10,900 gausses in the pole piece. The remanance is 4,750 gausses. Fig. 52 is a phantom of the American receiver with the diaphragm removed.

RECEIVER OF THE KELLOGG SWITCHBOARD & SUPPLY COMPANY.

The characteristics of the receiver of the Kellogg Switchboard & Supply Company are illustrated in Figs. 53 and 58, inclusive. At *A*, Fig. 53, the assembled receiver is shown. In Fig. 54 it is dissected into its component parts. In Fig. 55 and 56 is a sectional drawing. In one model the case consists of three pieces: the diaphragm cap, the case body and the tail piece, as shown in the sectional drawing (Fig. 56). In the model of Fig. 54 there are only two parts: a body and diaphragm cap. The magnetic system (Fig. 54) consists of two bars .630 in. wide, .24 in. thick and 3½ in. long. These bars are secured by means of a bolt and non-magnetic block at the pole piece end and iron screw and magnetic filling piece at the rear. The diaphragm is of ferrotype .011 in. thick, 2.18 in. over all in diameter, with a free diameter 1.93 in., and is perfectly flat. The line coils are wound upon brass spools .41 in. wide, .90 in. long and .62 in. deep; the wire is No. 30 and the resistance from 65 to 70 ohms. The pole pieces are .54 in. wide, .10 in. thick and 1.25 in. long; they are secured to the magnet by recessing the ends of magnet bars and by bolting the pole pieces with the same bolt that secures the ends of the magnet. In order that the receiver may be heavy enough to hold the switch hook in its proper place a lead weight is cast between the magnet bars, as is seen in Fig. 54. The tractive effort is 2.437 pounds (1,170 grams). This corresponds to a tractive effort 1,620 grams per sq. cm., indicating an induction in the pole pieces of 12,300 gausses, and a remanance in the magnets of 5,400 gausses. The case is faced

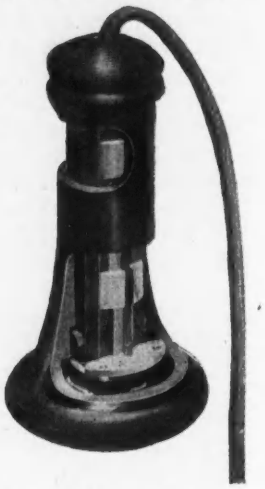


FIG. 55.—SECTION OF KELLOGG RECEIVER.

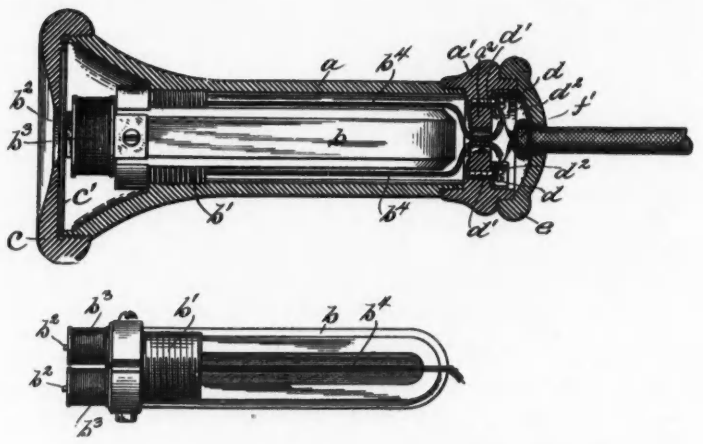


FIG. 56.—ANOTHER MODEL OF THE KELLOGG RECEIVER.

off perpendicular to the axis of the magnet and the diaphragm secured by clamping it to the face of the case and the underside and the inside of the cap. In Figs. 54 and 55 it will be noticed that between the pole pieces and the magnet bars a round disc of non-magnetic metal is placed, which is parallel with the face of the pole pieces. As is shown in Fig. 55, the inside of the case carries a shoulder which is machined to be parallel with the face of the case. When the magnetic system is dropped into place the disc bears against this shoulder and the whole magnetic system is secured in place by four screws, which pass through the disc and into the case. Thus, in this model the diaphragm and the magnetic system are supported by the case, but as the points of support are quite close together there is little danger of loss of adjustment.

Niagara Falls Meeting of the American Electrochemical Society.

THE fourth general meeting of the American Electrochemical Society, held at Niagara Falls last week, had a registered attendance of 138 members and guests. On each morning a session was held, devoted to the reading and discussion of papers, while on the afternoons excursions and visits to electrochemical plants and other points of interest were made. A smoker with an enjoyable vaudeville program on Thursday evening and a reception with dancing on Friday evening were well attended by the members and guests, while for Saturday an excursion by boat and trolley was arranged along the gorge to Fort Niagara. Upon the whole, the meeting was a very enjoyable affair, for which credit is due to the activity of the local committee and especially its indefatigable secretary, Mr. Clarence L. Collins, 2nd.

The plants which invited the Society as a whole to visits were the several Niagara power plants, the Niagara Research Laboratories, and the National Battery Company, in Buffalo. The storage battery made by the latter company is well known to our readers, one of its special features being Mr. Sperry's pyroxyline envelope. The Niagara Research Laboratories are a new departure in the development of electrochemistry. The company was founded to maintain a research laboratory for scientific investigation in the field of chemistry, electrochemistry and electrometallurgy, to do analytical and experimental work for the general public and to act as consulting engineers in perfecting or improving existing processes. They also rent space and power for chemical and electrochemical investigations. The three-story building contains, on the main floor, a transformer and motor-dynamo plant; the electric furnace room with furnaces of various sizes for experimental purposes; machine shop; and various rooms for rent. The second story contains offices, library, the electrolytic room with a nicely equipped electrolytic bench, and the analytical laboratory.

Several of the electrochemical plants had extended invitations to groups of individual members. Among them were the Acker Process Company, the Electrical Lead Reduction Company, and the promoters of Mr. Ruthenburg's experimental iron furnace plant. The process of the Acker Company, which has already been described at length in these columns, has been in continuous and successful operation since 1901, and is the only commercial process in which fused salt is electrolysed. The Electrical Lead Reduction Company has installed an entirely new form of apparatus which will be described below in the abstract of Mr. Salom's paper. Mr. Ruthenburg's iron furnace is installed in the works of the Cowles Company at Lockport, near Niagara, and will be referred to in the abstract of Mr. Ruthenburg's paper. Below are given condensed abstracts of all the papers presented at the meeting.

On Thursday morning the meeting was opened by the reading of the reports of the secretary and treasurer. The membership list has now passed the 600 mark, and the treasurer reported a surplus of $2,000. The establishment of local sections has been taken into consideration and the first local section will be founded at Madison, Wis.

THEORETICAL CONSIDERATIONS IN THE CONSTRUCTION OF RESISTANCE FURNACES.

Mr. Francis A. J. Fitzgerald presented a note on some theoretical considerations in the construction of resistance furnaces, a reprint of a portion of which appears elsewhere.

The author gave several formulas as of use as a guide in the design of a resistance furnace, although they cannot be rigorously applied, because several factors are neglected in the assumptions.

In the discussion Prof. Burgess asked what is the power factor in such furnaces; Mr. Fitzgerald replied that in the early types of furnaces there was considerable self-induction, with a correspondingly low power factor; but by special arrangements, like interlacing the bus bars, the conditions were improved. Mr. A. H. Cowles spoke of some early experiments made by him with carborundum; he claims that the current passes not only through the core, but also through the carborundum; Mr. Fitzgerald denied the correctness of the latter statement and Prof. Burgess said he had found carborundum to be an extremely poor conductor compared with carbon.

ELECTROMETALLURGY OF IRON.

Mr. Marcus Ruthenburg, of Lockport, N. Y., presented a paper on advances in electrometallurgy of iron production and stated that while in a paper presented last year he asserted that the work of his electric furnace was performed upon a ton of ore with something less than 500 kw-hours, he is now prepared to say that he does now the same, but better work, with an expenditure of about 250 kw-hours. This energy is used only for melting the iron ore, but not for its reduction. In his present form of furnace the powder of magnetic ore which has been previously concentrated by means of magnetic separation, falls into a magnetic zone between two slowly revolving rolls; here the material forms a bridge, due to the action of the magnetic field. When the material forming the bridge is electrically smelted, it becomes non-magnetic and drops down into the soaking pit, while new material forms a new bridge and so on.

The electric current serves only for melting the material and agglomerating it so as to be in a form ready for reduction. The reduction itself takes place in the soaking pit below through which CO or hydrocarbons are passed. The three principal points of the process were first the power required for agglomerating and sufficiently treating the material for subsequent reduction; second the regulation of the size of the agglomerated particles; third, the reduction of the agglomerated particles. The present status of these three problems is said to be, first, that 250 kw-hours are required for the agglomeration of one ton of ore; second, that the size of the product is under perfect control; third, that the reduction of the mass in the soaking pit by means of hydrocarbons is complete. Inasmuch as the only function of the electric current is to agglomerate the dusky particles into coherent masses without binder or flux, and to convey a sufficient quantity of heat to the ore in the soaking pit, to permit the reducing agents to perform their function, it is evident that the heat and current losses due to maintaining a molten mass are lacking which are present in other furnace processes.

In the discussion Dr. Scholl, having asked for analysis of the material, Mr. Ruthenburg said that phosphorus is controlled by the preliminary magnetic treatment, but if phosphorus should be in the charge supplied to the furnace it is not eliminated; sulphur is said to be eliminated, and magnetic ore is itself low in sulphur. Mr. Cowles said he had seen the furnace in a run lasting for several days; the finest point is that the only material which drops into the soaking pit is iron oxide after it is fused. When accumulated in the soaking pit one has a heated mass in a retort through which heated hydrocarbon gases may be passed to produce reduction; he also gave some theoretical figures on the process.

THE PASSIVE STATE OF IRON.

Prof. C. F. Burgess presented a paper on a practical utilization of the passive state of iron. It has long been known that iron and steel assumes that peculiar condition known as the passive state by employing the material as an anode in sodium nitrate or various other soluble nitrates. Upon assuming the passive condition, the iron no longer becomes attacked by the anode products, and behaves like a platinum anode. Some years ago he developed in his laboratory a process for removing brass from steel tubing, the brass having been left on the outside of the tubing as a superfluous material during the brazing process. It was tried to employ an electrolytic stripping process for removing the brass, but in a great many electrolytes the iron tended to corrode much more readily than did the copper which enters into the constitution of the brazing spelter. Iron has a position considerably above copper in the electrochemical series of elements, and where two different metals are in contact, the natural tendency is for the more electropositive one to go into solution with the greater ease. The idea presented itself of making the iron more electronegative than the copper by causing it to assume the passive state, and upon using the sodium nitrate solution in which this state could be developed it was found that the brass could be completely removed and the iron left intact. This method of electrolytic stripping was installed and operated with success in various factories, and is now an important adjunct to the dip-brazing method. This same electrolytic stripping process may be applied equally well in removing silver, lead, tin and other metals more electronegative than iron from an iron surface. Nickel cannot be removed in this way, since it assumes itself the passive state.

The author gave some measurements of the single potential of iron, with the use of the calomel standard electrode. The single potential of iron immersed in a sodium nitrate solution before the current is passed, is in the neighborhood of + 0.2 volt; by causing the current to pass from the iron anode, however, the potential quickly becomes negative and increases rapidly in negative value up to — 2.0 volts under certain conditions.

ELECTROLYTIC DETERMINATION OF THE BASCILITY OF ACIDS.

Mr. Ivar Juel Moltkehansen presented a paper on an experiment on the electrolytic determination of the bascility of acids. One of the most difficult problems of inorganic chemistry is the constitution of metaphosphoric acids, which can only be determined by analysis of their double salts. A decision as to the constitution of the metaphosphates, soluble in water, is possible from measurements of their electric conductivity, in combination with Ostwald's dilution law. This method is applied by the author for ammonium metaphosphoric acid. His results speak for the existence of dimetaphosphoric acid of the ammonium salt, with two molecules of water of crystallization, according to the formula $(NH_4PO_3)_2\ 2H_2O$.

ELECTROMETALLURGY OF GOLD.

A paper on this subject was presented by Dr. W. H. Walker, of Boston, Mass., giving a review of the present commercial situation in this field. The electric current is used both for dissolving gold in potassium cyanide and for precipitating it from the solution. For the first purpose, the effect of the current is to produce oxygen, as it was early discovered that the presence of oxygen is necessary for the dissolution of the gold. The processes for recovering gold electrolytically from cyanide solutions may be divided into two classes. The first class comprises the processes in which the gold is first dissolved in a tank and afterwards recovered electrolytically. The Siemens & Halske process belongs to this class, and is used on a large scale in South Africa. The other class comprises those processes in which the solution and precipitation of gold are carried on simultaneously. The Pelatan-Clerici, the Riecken and the Aurex-Sluice processes belong to this latter class, and have not been found to be commercially successful, the reason for their failure probably being due to the fact that large quantities of ore are required to recover a small quantity of gold, and that these large quantities of ore must be continually moved. The author then gave an account of some experiments made by him with a telluride gold ore and explained why some processes which worked well in the laboratory have not been successful on a large scale. The fact is that to recover the gold by cathodic precipitation, the ions containing gold must be continually in contact with the cathode; this was not appreciated by the early experimenters.

In the discussion Mr. Bancroft said that the Siemens & Halske people are not using the Siemens & Halske process in South Africa, but the Andreoli process. Dr. Richards remarked that the efficiency of the electrolytic gold recovery is very small, but that the cost of power does not cut any figure in the economical production of gold from ores.

ELECTROLYTIC COPPER REFINING.

Dr. Wilder D. Bancroft presented a paper on electrolytic copper refining, in which he gave an account of a series of tests made in Cornell University to find the most economical conditions. The principal factors varied in these experiments were the temperature and the current density. Two sets of curves were plotted, one showing the relation between the cost to precipitate a ton of copper and the temperature of operation; the second set showing the relation between the cost to precipitate a ton of copper and the operating current density. From these curves it appears that a temperature of 70° is most satisfactory. Although the cost runs very high at this temperature for a current density of 1 amp. per sq. dm., it begins to drop off very rapidly as the current density increases, until it assumes a practically constant value at the higher current densities. Between 3.5 and 3.75 am. per sq. dm. would be the best current density for obtaining economical results, for at this density no extra power would be required to heat the solution. Operating at this current density, and with covered tanks, in order to prevent the heavy radiation losses, the current alone would be sufficient to heat the electrolyte to over 80°. In order to secure a good circulation, essential for a good deposit with high current densities, the present method of pumping could be retained. If the gutters leading to and from the pump were properly insulated the solution would not drop below 70° before returning to the tanks. Moreover, running at this high current density, there would be a considerable saving in the first cost of the plant, inasmuch as fewer tanks are needed for the precipitation of a given amount of copper in a given time. The lower the cost of heating, the greater the advantage of a high temperature. The author sums up the results of the investigation by recommending, first, covered tanks; second, a current density of 3.5 amp. per sq. dm.; third, a temperature of 70° C.

The paper of Dr. Bancroft was discussed by various copper refining engineers. Mr. Lawrence Addicks, of the Raritan Copper Works, said in a communicated discussion that electrolytic refining consists, from the standpoint of economy, in a very nice balance of a number of conditions, and that Dr. Bancroft has considered some, but has overlooked others, for instance, labor cost. The idea of covered tanks would be greeted with much hesitation by most refiners, for it is hard enough to get thorough inspection with an open tank. Every refinery is charged with interest and depreciation of plant, and these are not considered by Dr. Bancroft; he thinks that these charges would revolutionize Bancroft's cost tables. He sums up his criticism by saying that current density and temperature bear vital relations to the cost of refining, and that Dr. Bancroft has furnished valuable data concerning these items; for some refineries his conclusions may be correct, but not for all.

Mr. Benjamin Magnus, of the Anaconda works, gave as a result of his experience that the ampere-hour efficiency depends entirely on mechanical conditions. He seriously objects to covered plants and refers to the conditions used by the Anaconda refinery, where the current density is 10.5 amp. per sq. ft., the temperature of the electrolyte is 100° F. and the circulation of the electrolyte 3 gallons per minute. Under these conditions the chemical action in the tank is 1 per cent. greater than the electrolytic action, and the voltage per tank is 0.23 volt. In order to keep the solution constant day by day, the extra copper taken up by the solution is taken out by means of a tank with insoluble anodes. The cost of operating this tank in which the voltage is 2, is at least 8 times the cost of operating a regular depositing tank. If a temperature of 70° C. should be used and the current density be raised to 31.5 amp. per sq. ft., the excess chemical action would be so great that to free the electrolyte from copper by means of tanks with insoluble anodes, would cost so much that the saving of power due to warmer solutions would be more than offset.

Mr. Woolsey McA. Johnson said he had plotted for nickel curves similar to those of Dr. Bancroft for copper, and pointed out that the results of such curves must be translated freely into practice. He also criticised some special assumptions of Bancroft which he considered as unwarranted.

Dr. Bancroft, in his reply, said that in his paper he had clearly stated all assumptions which he had made, and that he had intended to give exact figures concerning current efficiency and temperature; this he has done and every refinery is now enabled to make the calculations of cost for its own case, taking their own figures for the other factors, purposely not taken into account, in his paper. He considered that the difficulty of covered tanks was greatly overstated. If the covers are so arranged that they will swing or lift open easily, the only difference will be the slight extra time necessary to raise the covers. The fact that by means of covered tanks, nothing else being changed in the present arrangements, a saving of 30 per cent. in power may be accomplished, should certainly be of interest.

EFFICIENCY OF THE NICKEL-PLATING TANK.

Prof. Oliver W. Brown presented a paper on this subject, which in the absence of the author was read by Mr. W. McA. Johnson. The design of the present nickel-plating solution has been the result of the "cut-and-try" process, and few attempts have been made to give a good scientific explanation of why some solutions give better results than do others. Platers have also turned their attention mostly to the cathode and less to the anode, although a high current efficiency can only be attained if the anode corrodes at the same rate as the metal is deposited at the cathode. The nickel-plating cell is notably inefficient from this point of view; there is not only the resistance of the electrolyte to be overcome by the applied voltage, but an additional counter e.m.f., amounting in some cases to over two volts. To study the problem, the author has determined the single potentials of anode and cathode separately, by means of a standard electrode.

His results show that electrolytic nickel anodes corrode very poorly as compared with cast nickel anodes; pure rolled anodes are no better than electrolytic. The cathode efficiency is affected to a marked degree by the anode efficiency. The satisfactory operation of a nickel-plating solution depends to a large extent on the character of the anode employed. The purest anode material is not the best; presence of copper is advantageous to a certain extent, and it is quite likely that certain other impurities which are usually present in cast nickel may be equally advantageous. The reason that cast nickel anodes show a superiority may be due to the impuri-

ties or to a different physical structure which gives rise to a great porosity and roughness of the surface, and thereby a greater actual surface area. The electroplater can obtain an efficiency of 90 per cent. or more if cast anodes are used, with an anode density of about 5 amp. per sq. ft.

In the discussion Mr. W. McA. Johnson recommended to electroplaters the author's method of studying the anode and cathode potentials separately by means of a standard electrode, but he thought that for the average plater the cost of standard electrodes and potentiometer would be too high. Prof. Burgess did not consider the cost to be excessive and referred to the great convenience of using the Ostwald mercury standard electrode. There was also some discussion between Messrs. Gahl, Reed and Richards concerning overvoltage.

A NEW TYPE OF ELECTROLYTIC CELL.

A paper on this subject was presented by Mr. Pedro G. Salom. His process of reducing galena to lead consists, as is well known, in the use of galena as cathode in sulphuric acid, the sulphur going off as hydrogen sulphide. In his early experiments with this process, the chief difficulty encountered was the incompleteness of the reduction. It was found that this was due to the use of too thick a layer of ore, by diminishing the thickness of the layer, the reduction becomes more and more complete. At the same time the use of a much higher current density than formerly used becomes thoroughly feasible. But these improvements would have been impracticable with his old type of cell; he has, therefore, devised a new type of cell which has another important advantage, namely, that the process now becomes continuous.

The cell looks somewhat like a wheel in horizontal position; it consists of an annular body of a trough-shaped cross-section made of antimonial lead and being used as cathode. The anode consists of a series of segmental plates, supported by a spider frame and bridging the spaces between seven of the eight arms of the spider frame, the space between the seventh and eighth arm being left open. The anode is rotated and the gases developed are led off through a pipe. A box filled with crushed galena is arranged in the open space between the seventh and eighth arms of the spider frame, and is provided with a feeding slot through which the galena is supplied to the bottom of the cell. A scraper plate sweeps the spongy mass out of the apparatus while the anode rotates. The author states that this cell should be also useful for other electrolytic processes than the reduction of galena.

ELECTROLYSIS OF SODIUM HYDROXIDE BY ALTERNATING CURRENT.

In a paper with this title, Mr. Carl Hambuechen, of Madison, Wis., described a method for producing electrolysis by connecting an electrolytic cell directly to a source of alternating pressure. As alternating current is largely used for transmission of power, its conversion into an undirectional current is a matter of moment to electrochemists; it is possible to avoid rotary converters or motor-generators, if aluminum is used as one of the electrodes in a cell in which electrolytic decomposition is to be effected. This follows from the well-known property of an aluminum electrode to permit the passage of current in one direction, but not in the other. The author applied this principle successfully to the electrolytic production of sodium from fused sodium hydroxide, the efficiency of the process being high.

ELECTROLYSIS OF WATER.

A paper presented by Messrs. J. W. Richards and Walter S. Landis was an account of a continuation of the researches of the authors on this subject, a first paper having been presented by them at the last meeting of the society. In their former paper they have shown the application of Ohm's law to dilute sulphuric acid for voltages up to 3.5 volts. In the course of their new experiments with somewhat modified apparatus, they found that there are two very important factors to be taken into account, viz.: the current used and the size of the electrodes. The current must be kept within the limit of that which can be completely depolarized by the gases in solution in the electrolyte. The electrode surface must be large enough to allow this depolarization to take place simultaneously with the decomposition. The smaller the electrodes used, the greater the polarization.

An interesting fact ascertained by the authors is that an evolution of gas can be obtained at about 1.1 volt at a small electrode, if opposed to a large one, and that this is true for oxygen as well as hydrogen. At the larger electrode there is enough dissolved gas in the solution to act as depolarizer. The results obtained by the authors concerning the diffusion current agree well with those of Bigelow.

In the discussion Mr. Reed said the evolution of gas at a small electrode, opposed to a large electrode, may be explained by the assumption that the latter forms a compound with the ions and acts as depolarizer. Mr. Hering thought that in the measurements of the authors there was an ambiguity concerning the time when the readings were taken. Dr. Gahl spoke on overvoltage. Dr. Richards, in his reply, said that the readings were taken seven seconds after closing the circuit, because this was the time required for letting the needle of the measuring instrument come to rest. They could not find any chemical effect on the platinum, nor did the current depend on the condition of the platinum.

ELECTROLYSIS OF WATER VAPOR.

Mr. F. Austin Lidbury, of Niagara Falls, presented a paper on the supposed electrolysis of water vapor, due to a discharge of electricity through steam. In experiments which the author has made in conjunction with Mr. D. L. Chapman, he made the interesting observation that in the partial decomposition of water vapor by the electric discharge the hydrogen and oxygen liberated tend to separate and to take up different positions in the tube, the hydrogen collecting at both anode and cathode and the oxygen in the middle of the tube. It appears that the process cannot be entirely analogous to ordinary electrolytic action, and further investigations are required in order to give a satisfactory explanation.

METALLIC DIAPHRAGMS.

A note on metallic diaphragms, by Dr. Eugene A. Byrnes, of Washington, D. C., was read in the absence of the author by Mr. C. P. Townsend. Various conducting materials become poor conductors when in finely-powdered form, and may then be used for metallic diaphragms. For instance, finely-divided lead may be used. Various mechanical arrangements for the construction of the diaphragm are possible; for instance, the finely-crushed material may be included between perforated iron plates, etc. For further particulars the reader may be referred to a recent patent of Dr. Byrnes, an account of which was given in ELECTRICAL WORLD AND ENGINEER under "Recent Electrochemical Developments."

GENERAL DISCUSSION OF THE ELECTROLYTIC DISSOCIATION THEORY.

As an introduction to this discussion a paper was read by Dr. E. F. Roeber on the theoretical properties of free ions in solution. The author discussed the use of physical analogies and mechanical models, as introduced by Maxwell in the theory of electricity, and said that the electrolytic dissociation theory should be considered from a similar point of view, electrolytic phenomena being illustrated by the model of traveling ions. The author gave a sketch of the facts of electrolysis and showed what properties must be attributed to the ions to suit the facts. In an "infinitely dilute" solution of uniform concentrations these properties are the electric charges, according to Faraday's law, and the specific mobilities of the ions, according to Kohlrausch; if there are differences of concentration in the solution no new properties are attributed to the ion, but it is assumed that only two kinds of forces are acting on the same—the electric forces due to the electrostatic charges, and the osmetic forces due to the concentration differences. These are all the suppositions made in Nernst's theory of diffusion and theory of concentration cells. For infinitely dilute solutions this model of ions has been found to represent the facts completely and correctly. For more concentrated solutions, Arrhenius has made the assumption that only a part of the dissolved molecules is ionized and active, while the non-ionized molecules are inactive. But here the fundamental difficulty is encountered that we have not yet an absolutely certain method for determining the degrees of dissociation, because the different methods applied for this purpose have, in numerous cases, given results which are not in agreement with each other. Nevertheless, the dissociation theory represents even for more concentrated solutions an approximation to the truth. A theory is a tool for scientific progress, and a tool should not be depreciated because it is not perfect.

Dr. Wilder D. Bancroft opened the general discussion and said that in recent years the dissociation theory has developed along two different lines. One class of workers have applied the theory to more and more new facts, and they have been very successful; the other in which Kahlenberg is a leader has looked for limitations of the theory, and they have also been very successful. Dr. Bancroft emphasized that the electrolytic dissociation theory really applies only to infinitely dilute solutions. He also called attention to the

fact that it has not yet been exactly proven that there are really abnormal molecular weights in solutions, so that the fundamental facts on which the thermodynamical support of the theory is based are not certain; we do not yet know whether the heat of vaporization of pure water is equal to the heat of evaporization of sodium chloride.

Mr. C. J. Reed gave a long list of those points in which he believes the dissociation theory to be a failure. He thinks that electric charges are always sources of energy and must evolve energy where they discharge; the change of an ion into an atom should, therefore, evolve energy, while in reality energy must be supplied from the outside. Another point raised by Mr. Reed against the dissociation theory is that it does not account for the electrolysis of fused salts. Mr. F. A. Lidbury answered some of the objections raised by Mr. Reed. Dr. W. Lash Miller spoke of an investigation in which he used Ostwald's dilution law to determine which are the ions of acetic acid, and then wanted to calculate the transport numbers; but the results were not in accordance with the facts, and he does not know yet how to explain them. Prof. Henry S. Carhart said that the dissociation theory has been a very successful working hypothesis, but there are very serious objections. He considered the term dissociation to be not good. We have to expect modifications of the theory.

Dr. J. W. Richards presented, as a contribution to the discussion, a paper on the thermochemistry of the dissociation theory. The paper was highly theoretical and cannot be briefly extracted. He considers the ionized state as a "combined state" and assumes the heat of neutralization of an acid and a base to correspond to the passage of water from steam to liquid. The calculation of the ionization heat, based upon his view, is in good agreement with the facts. As a further contribution to the discussion, Mr. C. J. Reed presented a paper on Berthelot's law relative to the electromotive forces of cells, based on the reciprocal action of saline solutions and soluble electrolytes. He showed that Berthelot's alleged proofs of this law were no proofs. He assumes the e.m.f. at the junction of two electrolytes to be zero.

Dr. H. M. Goodwin said that when investigations go on, one must expect disarrangements between facts and an established theory; this is the only way to perfect a theory. He spoke of the applications of the dissociation theory to the colors of solutions; he thinks that the view of the theory which considers the neutralization heat to correspond to the formation of a molecule of water from a hydrogen and a hydroxyl ion is simpler than Dr. Richards' view. Dr. Richards replied that his view is preferable because it enables him to calculate the neutralization heat, and the result agrees with the facts.

The Bell Telephone System in Philadelphia.

The recent merger of telephone interests in Philadelphia, with the policy of putting at the head of the system Mr. U. N. Bethell, general manager of the New York Bell system and head of the Washington system, gives interest to the affairs of the Bell Telephone Company, of Philadelphia. Its capitalization has been increased rapidly by successive issues of stock, from $3,500,000 at the beginning of 1900 and $2,500,000 in 1898, due to the extensive growth of the business, the number of city subscribers alone having recently been given as 42,000, as compared with 13,000 so recently as the beginning of 1900, when the company had less than $4,000,000 capital.

The successive increases and stock allotments are given by Philadelphia financial authorities in the following table:

Year.	Stock Outstanding.	Allotment.	Increased.
1898	$2,500,000	20%	500,000
1899	3,000,000	16 2-3%	500,000
1900	3,500,000	14 2-7%	500,000
1900	4,000,000	25%	1,000,000
1900	5,000,000	20%	.....
1900	6,000,000	16 2-3%	1,000,000
1901	7,000,000	14 2-3%	1,000,000
1902	8,000,000	25%	2,000,000
1902	10,000,000	20%	2,000,000
1903	12,000,000	....	.....

The market for the stock is a narrow one. The quotation has ranged from 70 to about 78 in the last three years, varying as the rights came off and regaining the high figure, substantially, each time. The highest price touched was 94, in 1899. The stock sold at 75 last June, and a few weeks ago an odd lot changed hands at 67. The company has continued to pay 8 per cent. dividends along with each increase of stock, and it is expected that the current year's earnings will exceed those of 1902, when the costs of maintenance, on account of some severe storms, were unusually heavy.

The development of the business is now particularly in the districts outside the city, which are covered by the Delaware & Atlantic Company, whose stock is owned by the Bell Telephone Company, of Philadelphia, and this company's published figures showed decided gains in number of subscribers. The Delaware & Atlantic territory covers all of New Jersey south of Trenton, the Counties of Berks, Montgomery, Chester and Delaware around Philadelphia, and the State of Delaware. The placing of the main arteries for the suburban lines underground has been accomplished at some points by the Delaware & Atlantic Company, at Wayne, Media, Ogontz and Norristown.

The American Telephone & Telegraph Company has always taken its proportion of stock in the Philadelphia Bell Telephone Company, 83 per cent. with each new issue, and holds over $9,600,000 of the $12,000,000 outstanding. Four financiers in Philadelphia hold about $1,000,000 more and another $1,000,000 or so is owned by the New York and Boston trust companies.

Westinghouse Electric Status.

A favorable analysis is made by financial authorities of the Westinghouse Electric figures just made available. The last balance sheet submitted by the Westinghouse Electric Company to stockholders was dated March 31, 1897. A comparison of the statement with the one recently published in connection with the application for listing new stock shows a remarkable gain in financial strength Working capital, or the balance of current assets over current liabilities, is now $12,134,395, compared with $2,093,146 in 1897, an increase of $10,041,249. This does not include stocks and bonds in the treasury, which have increased from $5,964,879 in 1897 to $7,251,385 in 1903. These securities are carried at cost.

The company's fixed assets, including property and patents, have increased from $7,816,089 in 1897, to $13,577,701 in 1903, a gain o $5,761,612. Besides this, there has been written off, according to one of the reports, $2,786,719, indicating a total expenditure of $8,548,331.

In 1901 $3,000,000 stock (par $50) was issued at $55 a share; and now $4,500,000 is being issued at $80 a share. When the new stock will have been issued total capital increase in the six years will have amounted to $10,853,000 (par value), and $3,865,000 proceeds from stock to issue is still to be added to working capital.

The surplus after dividends for the six years may be figured as follows:

Gain in working capital	$10,041,249
Gain in stocks and bonds owned	1,286,504
Gain in fixed assets	8,548,084
Total gain in assets	$19,876,084
Stocks and bonds issued (less retired) par value	6,353,711
Balance	$13,522,373
Less premium on stock sold	1,551,000
Balance, surplus earnings	$11,971,373

This amount is probably not far from the actual amount of earnings after dividends and interest since 1897.

The gain in working capital is a reflection of the rapid growth in the company's business. This growth may be seen in the following figures of gross sales for the years ending March 31: 1898, $4,378,060; 1899, $6,901,760; 1900, $11,963,646; 1901, $15,853,481; 1902, $19,975,958; 1903, $23,899,492; total sales, six years, $82,972,397.

Twenty per cent. of the above total gross sales would be about $16,500,000, which is probably the amount of net earnings before dividends and interest.

Telegraphers' Mutual Benefit Association.

The annual meeting of the Telegraphers' Mutual Benefit Association will be held at 195 Broadway, New York, on Wednesday, November 18, next.

Westinghouse Turret System of Electro-Pneumatic Car Control.

A few details and one or two illustrations have already been presented to the readers of this journal with regard to the new Westinghouse turret system of electro-pneumatic car control, and we are now able to supplement that matter by a number of interesting particulars entering more fully into the construction and modus operandi of this important advance in the field of electric traction. The data, as here given, are based upon an interesting exhibit made by the Westinghouse Company at the Saratoga meeting of the American Street Railway Association, to which reference was made at the time in these columns. As a matter of fact, however, the control has already entered into practical adoption, and is now being placed on several cars on the Manhattan Elevated Railroad, while 264 control equipments have also been purchased for the Brooklyn Rapid Transit System. In the turret control, which derives its name from the external appearance of the organism, the actuating mechanism is not directly connected to the main source of current supply, and the connections for the low-voltage control circuits are the only ones which have to be considered in the train operation. There are only seven battery wires required for the train cable, and the train cable carries only a pressure of 14 volts, thus doing away with high-voltage wires on trail cars and high-voltage couplings anywhere in the system. It follows that from the use of a separate electrical circuit the controlling apparatus can be worked even when the main

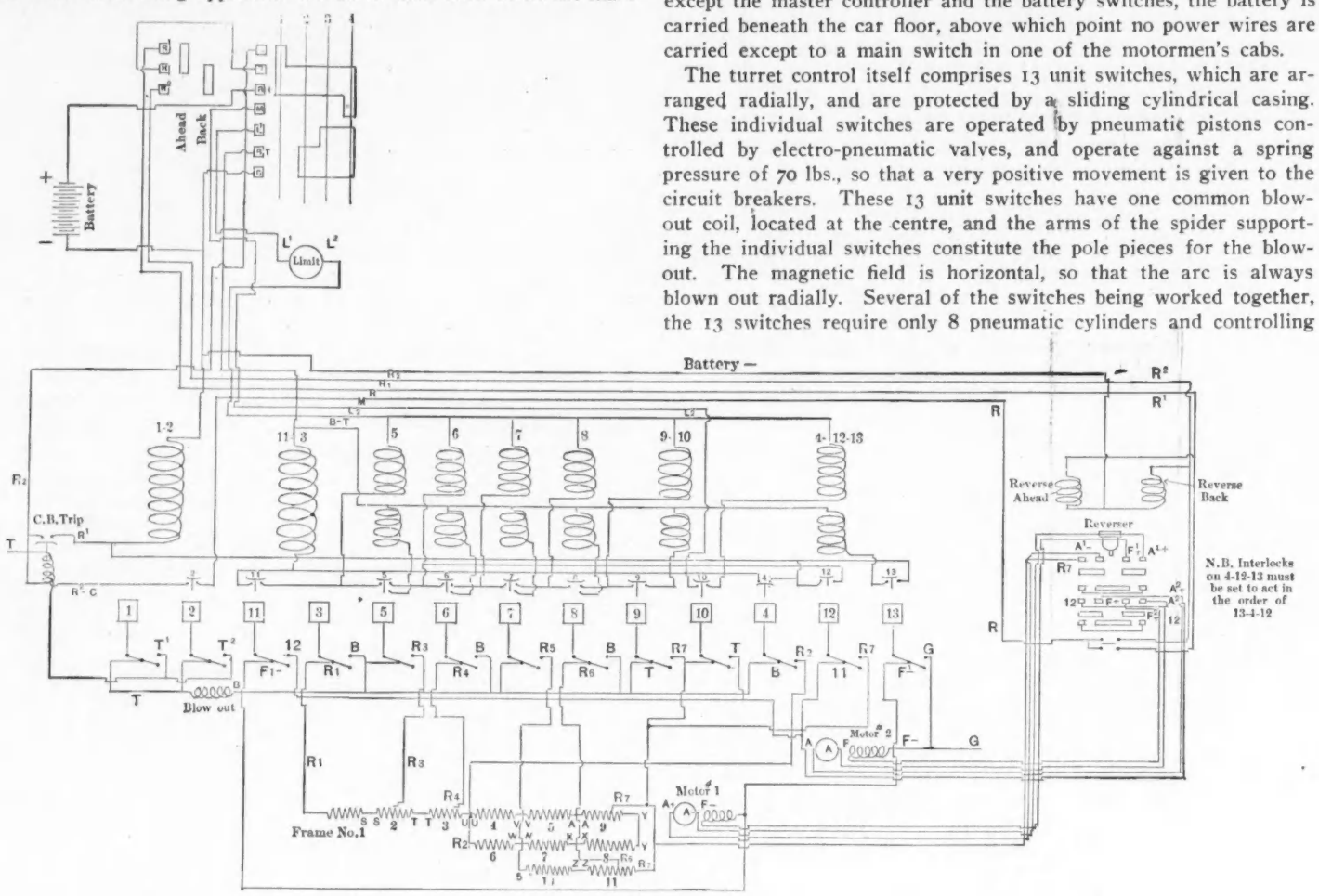


FIG. 1.—DIAGRAM OF WORKING CIRCUITS.

current is cut off, from any of the familiar causes, so that even when the third rail is dead the motors can be reversed and used for braking.

To take the system step by step, attention is called first to the master controller and the air-brake operating valve, which are shown mounted on the inside end panel of the motorman's cab on an elevated car. When the apparatus is not in use the door of this compartment shuts against the end panel, so as to enclose the apparatus. The master controller is only 7½ inches high, 6 inches wide and 4½ inches deep, and is so placed that the controlling handle is 2 ft. 10 inches from the floor. The rotating cylinder of the master controller is of wood, with copper plates and copper spring fingers. The reverse cylinder interlocks with the controller cylinder in a simple manner, so as to prevent the movement of the former unless the latter is at the "off" position, and also prevents the movement of the controller cylinder, unless the reverse is open, over the forward or the backward step. Moreover, the master controller handle is fitted with a spring return, which makes it a "dead man's handle," and it is so constructed that should the motorman lift his hand at any time from the controller handle the brakes are at once automatically applied, unless the reverse handle has first been turned to the center position. By similar mechanism, if the brakes are applied while the current is still on, the current is automatically cut off. These points are accomplished by means of a connection between the spring return handle and the air-brake system for setting the brakes; while the release of the brakes is effected by a connection between the air-brake system and a small air cylinder, the piston of which opens the battery circuit.

Immediately below the master controller is the junction box to which the seven-battery wires above referred to are brought, this box being 13½ inches high, 5 inches wide and 3 inches deep. The batteries themselves that are used for operating the electro-pneumatic switches are of the well-known "Chloride" type, and two sets are employed in order to insure absolute continuity of function, each set consisting of seven cells. The battery box is 16½ inches by 16½ inches by 25 inches, and with the cells weigh complete 300 lbs. Each set of batteries is in series with a set of lamps for charging from the line current. It will be noted that like everything else except the master controller and the battery switches, the battery is carried beneath the car floor, above which point no power wires are carried except to a main switch in one of the motormen's cabs.

The turret control itself comprises 13 unit switches, which are arranged radially, and are protected by a sliding cylindrical casing. These individual switches are operated by pneumatic pistons controlled by electro-pneumatic valves, and operate against a spring pressure of 70 lbs., so that a very positive movement is given to the circuit breakers. These 13 unit switches have one common blow-out coil, located at the centre, and the arms of the spider supporting the individual switches constitute the pole pieces for the blow-out. The magnetic field is horizontal, so that the arc is always blown out radially. Several of the switches being worked together, the 13 switches require only 8 pneumatic cylinders and controlling valves. The pneumatic cylinders are drilled in the air reservoir casting, and thus piping between them and the air reservoir is dispensed with. In this turret control, by the use of air pressure operating against a spring, the liability of the welding or sticking of the contact surfaces is avoided. Moreover, the switch finger levers are made flexible so that when drawn up by the pneumatic pressure and released by spring pressure a slight rubbing movement of the contact surfaces is obtained, which also does its share in the prevention of any welding effect.

A diagram is shown herewith of the connections, and a view is also shown of the side of the Manhattan car as equipped with the

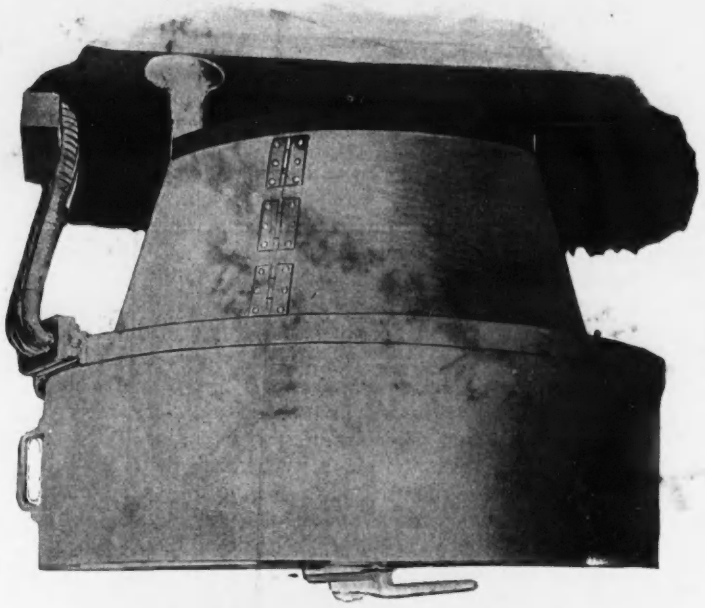


FIG. 2.—TURRET CONTROLLER WITH CASE CLOSED.

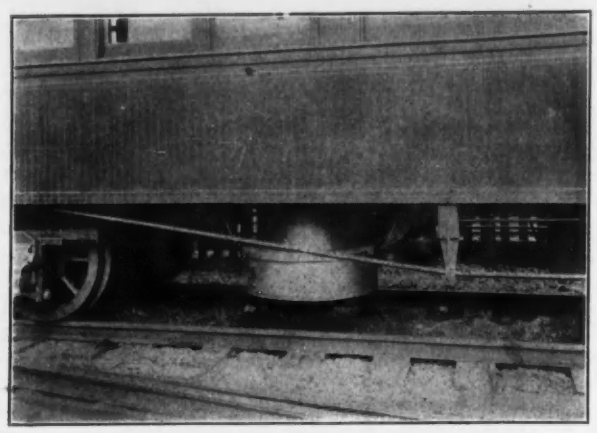


FIG. 6.—SIDE OF CAR SHOWING TURRET.

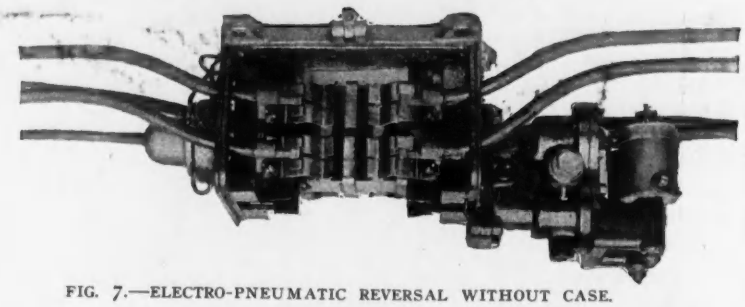


FIG. 7.—ELECTRO-PNEUMATIC REVERSAL WITHOUT CASE.

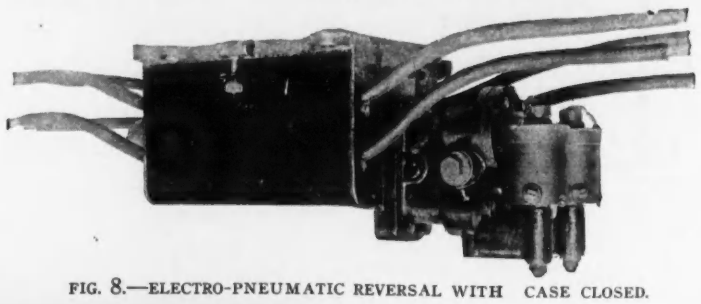


FIG. 8.—ELECTRO-PNEUMATIC REVERSAL WITH CASE CLOSED.

FIG. 3.—TURRET CONTROLLER WITH CASE OPEN.

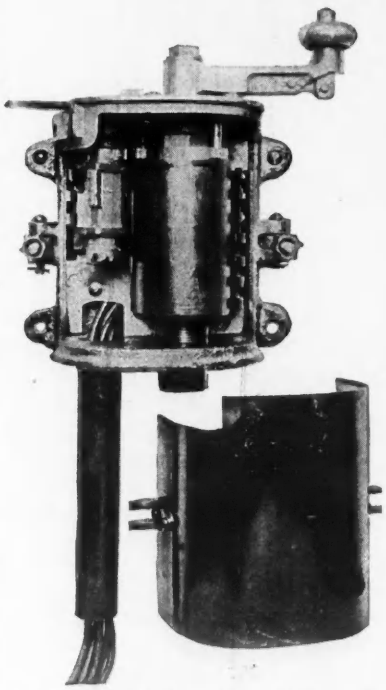


FIG. 4.—MASTER CONTROLLER UNCASED.

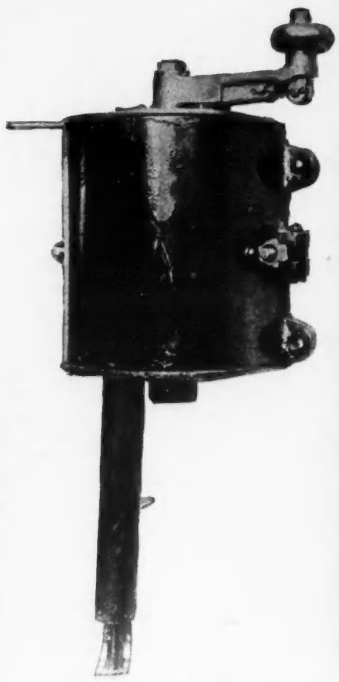


FIG. 5.—MASTER CONTROLLER WITH CASE CLOSED.

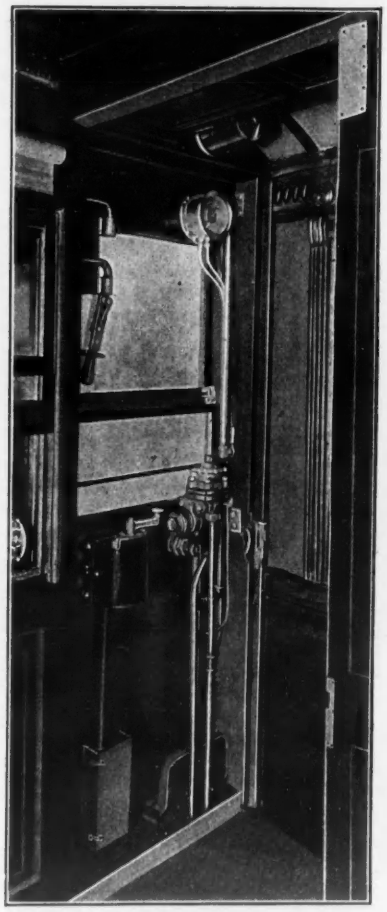


FIG. 9.—MOTORMAN'S CAB, SHOWING MASTER CONTROLLER, JUNCTION BOX AND AIR BRAKE OPERATING VALVE.

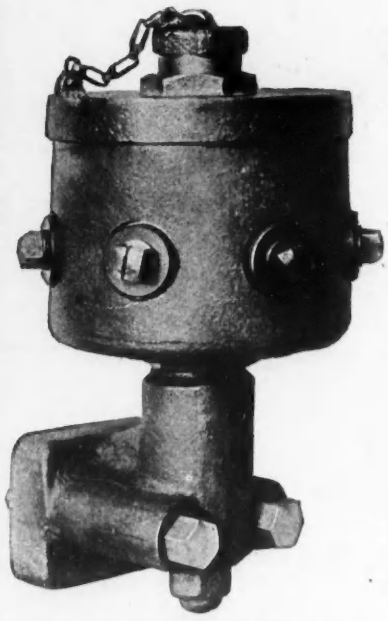


FIG. 10.—ELECTRO-PNEUMATIC VALVE.

TURRET SYSTEM OF ELECTRO-PNEUMATIC CAR CONTROL.

system. The reverse switch is of the usual type, with copper contacts, but is operated by two air cylinders controlled by electro-pneumatic valves worked from the reverse cylinder of the master controller. This reverse switch is placed as near the motor truck as possible to reduce the length of wire, and adjoining it is the limit switch governing the acceleration. In practice these two switches are usually mounted on the side of the car opposite from the resistance and the turret controller is placed in the centre.

Taking the diagram of connections, as shown in Fig. 1, the first step on the master controller throws the reverser. The circuit as thus constituted actuates the circuit breaker relay, controlling the two pneumatic pistons, 1 and 2, closing the circuit breaker. The second step places all the motors in series by actuating the pneu-

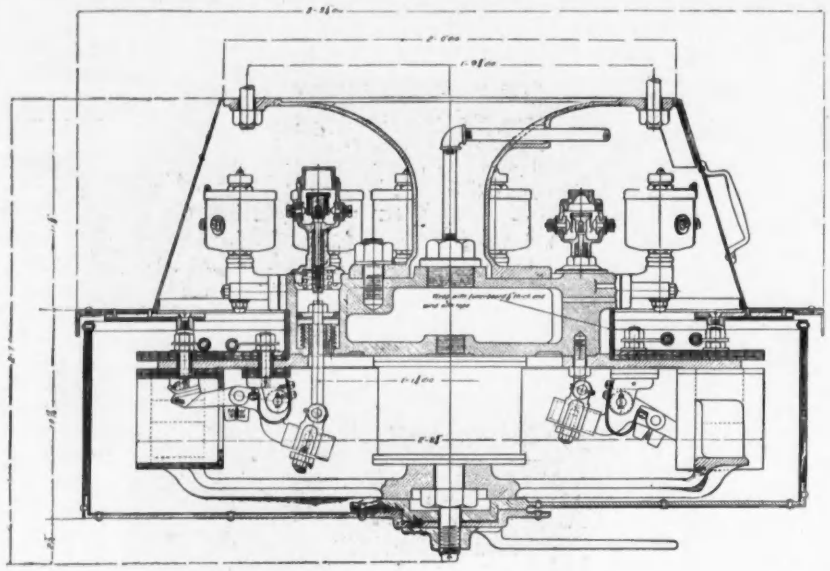


FIG. 11.—CROSS-SECTION THROUGH TURRET.

matic cylinders 11 and 3. These close the series connection and the connection through the rheostat *R*-1. At the third step, the resistances are cut out by closing the circuit through the limit switch and through coil No. 5. The action of the switch No. 5, in closing, establishes a circuit through No. 6, and this in turn as it closes establishes a circuit through No. 7, and so on throughout the full series up to No. 10, when all the resistances are cut out. Each piston in dropping to close its switch, closes also a holding con-

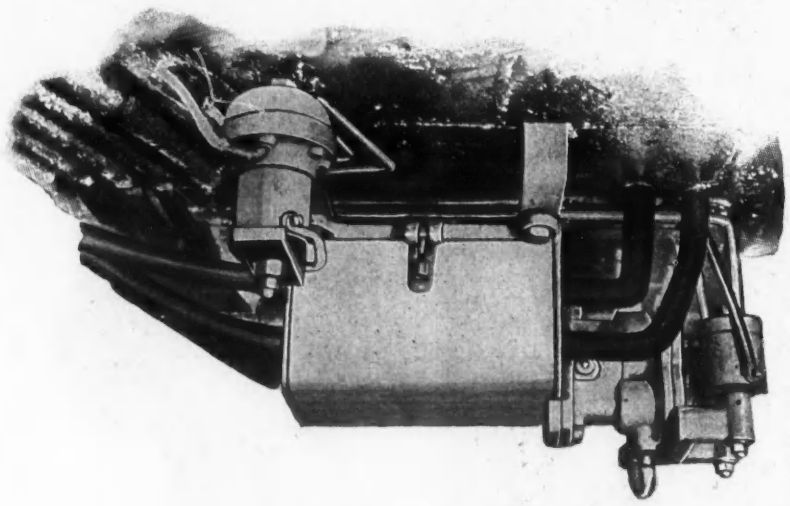


FIG. 12.—LIMIT SWITCH AND REVERSER.

nection seen directly above each piston, which cuts out the limit switch coil. This prevents the switches from opening when the limit switch acts, after they have once been closed; the limit switch simply preventing the next switch from picking up.

At the fourth position of the master controller the motors are in parallel. This result is obtained by means of solenoids 4, 12 and 13, and actuating switches of the same. These switches as they start to close, open the circuit on switches 3 and 11, and when they are fully closed, circuit is established through the holding coil. The current then starts to pick up the resistance coils controlled by switches 6, 7, 8 and 9, switch 6 being the first resistance used in the multiple position.

At the extreme left of the diagram will be noted a circuit breaker trip. This is actuated by the main circuit, and its object is to interlock the circuit breaker so that in case it opens while the power switch is closed, the circuit breaker cannot be reset until the power switch has been opened again.

The total weight of the complete apparatus, used on the Manhattan system is 1,711 lbs., inclusive of the battery. The wiring is very small in amount, and all the circuits are run in "electro-bestos" conduit. The air for the pneumatic switches is taken from the main train line, and is fed first to an auxiliary reservoir through a feed valve insuring uniform pressure, and passes thence to the air reservoir already referred to above as being located at the centre of the turret. A check valve is also provided with the auxiliary reservoir with the object of enabling it to retain sufficient air to operate the system in case the main supply should be cut off.

It will be obvious from this brief description that the new system has been worked out with great ingenuity and with careful forethought to provide against any emergency which might possibly arise in the operation of cars or trains. As here illustrated, the system is applied to only one car, but any desired number of cars can be operated from one master controller by carrying the battery connections from it to turret controllers upon motor cars constituting the train. The system has been worked out under the personal direction of Mr. George Westinghouse himself, and by the engineering staffs of the Westinghouse Air-Brake and the Westinghouse Electric & Manufacturing companies. It will be noted at once that the system is strikingly different from the company's "drum" type of electro-pneumatic control, and it must be a matter of interest and reassurance on the part of the public to observe how quickly improved methods are forthcoming as soon as the problems are indicated in actual service. The details of construction referred to above are shown very clearly in the series of illustrations, Fig. 2 to Fig. 12.

Recent Electrochemical Developments.

OXIDATION OF METALS DISSOLVED IN MERCURY.

In the familiar mercury cathode cell electrolysis of sodium chloride yields sodium amalgam, which afterwards gives off the sodium in a second compartment, with the formation of caustic soda. In a patent granted on September 15 to Messrs. Chas. E. Baker and Arthur W. Burwell, of Cleveland, Ohio, an apparatus for oxidizing the sodium is proposed which is essentially a short-circuited galvanic cell with amalgam as anode and carbon as cathode, the electrolyte being water or a dilute solution of caustic soda. The electrochemical action is oxidation of sodium to sodium hydroxide at the anode and evolution of hydrogen at the cathode.

The apparatus is a vessel containing a layer of amalgam at the bottom, and above it a solution of dilute caustic soda. Vertical carbon rods are placed in the vessel in contact, with both the amalgam and the water. Arc light carbons are suitable for use in this apparatus, if their outer surface is removed mechanically; the new surface, which always contains a small percentage of metallic iron, is readily wetted by mercury; as it is in a rough condition, the active surface is large.

STORAGE BATTERY.

A patent granted on September 15 to Mr. Fred A. Redmon, of Chicago, Ill., refers to a construction of a storage battery plate in which, for the firm support of the active material, a corrugated perforated metallic envelope is provided which surrounds an absorbent substance (such as burlap, matting or other fibrous fabric) containing the active material.

New Telephone Patents.

A DEPARTURE IN AUTOMATIC EXCHANGES.

The most interesting of the patents at hand for consideration this week are certainly four relating to various phases of a novel, automatic exchange apparatus. These patents all are granted to Messrs. J. J. Brownrigg and J. K. Norstrom, of Chicago, their rights being assigned to the Globe Automatic Telephone Company. With this system each line has connected therewith one switching machine and one pair of contacts in the contact bank of each other's switching machine. Thus far the system is akin to many others. The means for carrying out the switching processes are, however, novel, as the functions of the various electromagnets are merely that of control, all heavy parts being moved by an extraneous source of power.

Two developments of this idea and two kinds of calling switches are described in the patents, but for the sake of clearness it seems best to devote attention first to the rudimentary machine and then to touch upon its amplification to the requirements of a large system. Referring at once to Fig. 1, wherein are shown two views of the

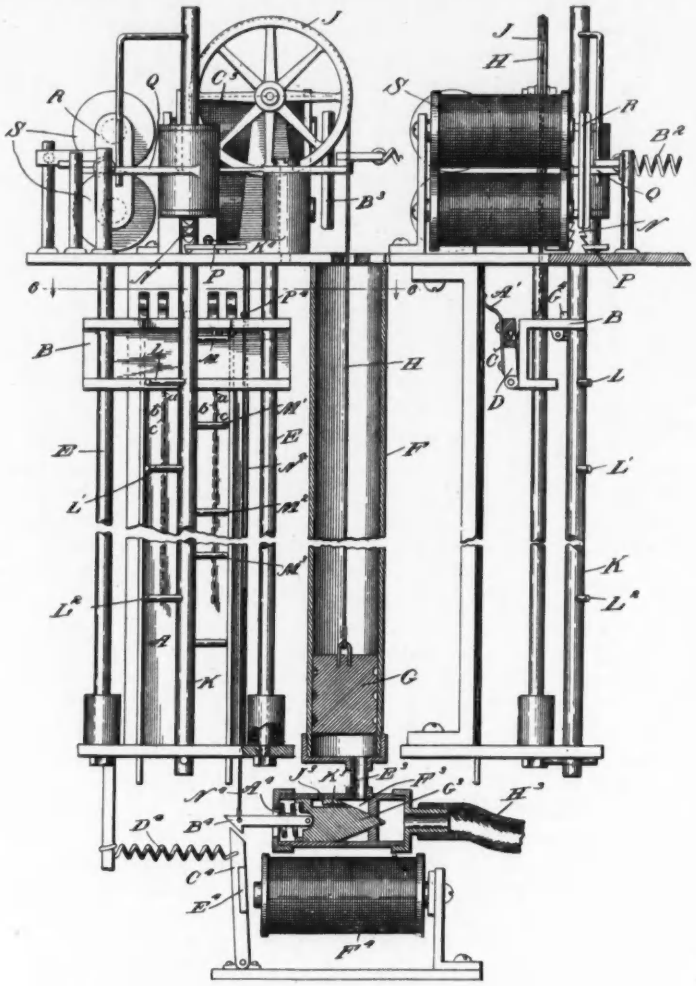


FIG. 1.—BROWNRIGG AND NORSTROM AUTOMATIC TELEPHONE SYSTEM.

simple machine, at *F* and *G*, is shown the extraneous power source, in the form of a cylinder with piston. Beneath the cylinder appears a valve. This controls an inlet port open to the atmosphere and an exhaust port open to a suction pipe, H^3. The weight of the parts is so adjusted that all forward switching movements are made by the action of gravity. As soon as a conversation is complete the release magnet, F^4, shifts the valve and all parts return to normal, the last operation being the releasing of the valve, to shut off the power.

The sequence of operations taking place in carrying out one call can best be explained by referring simultaneously to the circuits and apparatus. Fig. 2 shows the circuits, including a rudimentary subscriber's calling switch. Sliding upon the frame of the machine will be noticed a carriage *B* carrying two contact wipers. This carriage travels over the face of a contact bank *A*, consisting of two conducting bars *cc* connected to the calling subscriber's line, and contacts *aa* connected serially to the various other subscriber's lines. The wipers on *B* pass over the bars and contacts as the carriage travels, but only a single pair of contacts is connected to the conducting bars at the same instant. The carriage *B* when free to move will fall by its own weight. It is normally restrained by the stop pins, $L\,L^2$, $M\,M^2$, projecting from the shaft *K*. These pins are so spaced that in passing from one pin *M* to the next the wipers will run over ten contacts. There is another vertical adjustment, a motion of the whole shaft *K* in steps of one unit, or the distance between successive contacts. The magnet, C^3, with its armature and fall, controls this movement.

Now suppose our subscriber desires number 63. Six impulses sent by key a^6 will energize magnet *S* six times, current being received over common battery wire, a^3. The armature of magnet *S* is linked to shaft *K* to rock it against its retaining spring. Thus shaft *K* will rock forward and back once for each impulse and thereby for six impulses drop the carriage to contacts number 60. The next operation is the sending of three impulses by key a^7. Thereupon magnet c^3 responding through its rachet escapement lowers the carriage three units to number 63. Connection to subscriber 63 is now complete and a signal call and conversation may be carried out in the usual manner. When the conversation is completed, keys a^6 and a^7 are to be simultaneously depressed to cause magnet F^4 to operate and catch the valve rod so as to cause the returning armature of F^4 to shift the valve and restore the carriage.

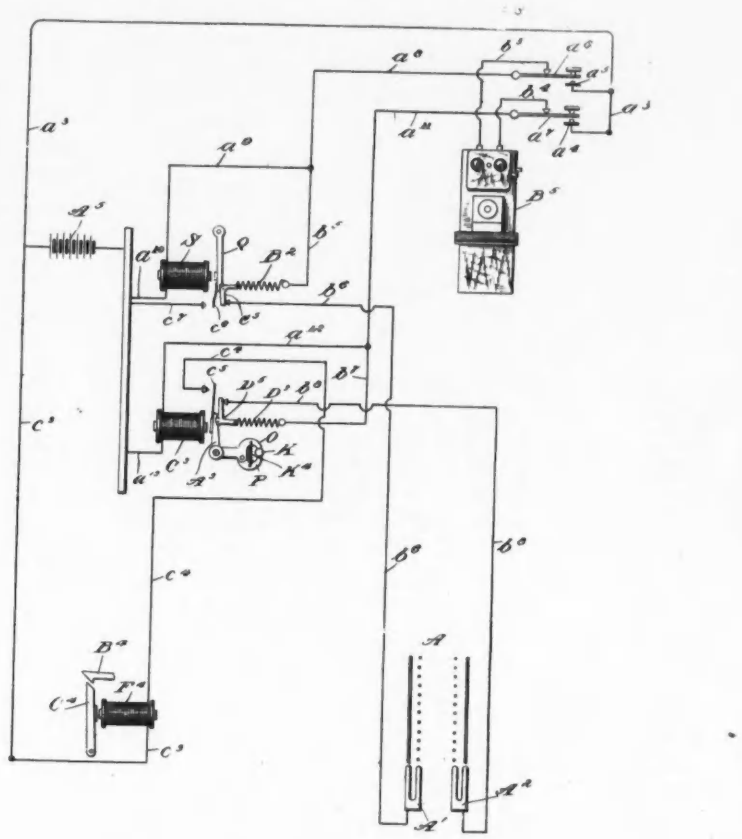


FIG. 2.—DIAGRAM OF CIRCUITS.

In order to make such a system suitable for more lines than can be conveniently arranged in a single pair of vertical rows, the number of rows is increased and a laterally moving carriage is arranged to move along the main carriage so that the wipers may be made to travel over any desired vertical row. This laterally moving carriage is moved forward by a spring and returned by the air cylinder exactly as is the main carriage. No additional electromagnets are required for the switching, as one magnet controls both cross and long vertical feeds. This is made possible by arranging the short or shaft feed intermediate, in point of time, with the long and lateral feeds. When the shaft is in the returned position the lateral feed only is controlled and when the shaft has moved one or more unit steps from its normal, then the long feed only is affected.

The automatic calling switches serve to replace the hand keys of the preceding description, and after once being set carry out the necessary contacts and combinations of contacts to effect the desired

call and to restore the apparatus when the conversation has been completed. A busy signal device has also been provided for the system, but the action of this will be apparent from a study of the patents.

FIRE ALARM ATTACHMENT.

A very simple fire alarm attachment for telephones is the subject of a patent issued to Y. D. Peachey, of East Orange, N. J. A weight is secured to the telephone receiver by a cord in a manner such that when the alarm bell sounds, a co-operating latch releases the weight and removes the receiver from the hook, sending a call signal to central. When the operator answers she is supposed to hear the bell and report the fire.

Acheson Electric Furnaces.

At the meeting last week at Niagara of the American Electrochemical Society, Mr. Francis A. J. Fitzgerald read a paper, in which he discussed the conditions for efficiency of several forms of electric furnaces of the type in which the current passes along a definite path or paths, thus localizing the heat. From this paper we reprint below a description of the several types of electric furnaces that have been developed by Mr. E. G. Acheson.

Graphite Furnace.—In this furnace the highest temperature attainable is desired. The carbonaceous material, anthracite coal, coke, etc., is placed in a trough-like furnace, and through the centre of the charge is a series of carbon rods connecting the furnace terminals. Anthracite coal, the raw material usually employed, is practically a non-conductor of electricity, and at first the current passes through the core of carbon rods. The heat generated in the core converts the surrounding coal into graphite, which then becomes a conductor and heats another layer of coal, and so on till the process is complete. This furnace belongs to both sub-classes of the resistance type.

Electrode Furnace.—This furnace does not properly belong to the type above mentioned, but is peculiar in that the heat is mainly generated outside the articles under treatment. In the most general case the electrodes to be converted into graphite are arranged in piles, and the spaces between the latter filled with granular carbon. Since the resistivity of the granular carbon mass is much greater than that of the electrodes, most of the heat energy will be developed in the former. The advantage of this type of furnace is that it permits of treating a large mass of low-resistance material without using currents of excessive amperage.

Carborundum Furnace.—Carborundum is a substance that is decomposed at the temperature of the graphite furnace, hence in its manufacture careful temperature regulation is necessary. The charge, consisting of sand and coke, in the form of powder, is put in the box-like furnace, and through its centre passes a conducting core, which may consist of carbon in a granular form, or of carbon rods, connecting the terminals of the furnace. The current is confined to the core, raising it to a high temperature, and the heat generated is conducted into the surrounding mixture, converting it into carborundum. If the temperature of the furnace is too high, the carborundum is decomposed and the silicon vaporized.

Furnace for Moderately High Temperatures.—This is the latest of Acheson's patents, and is of great interest. In the outer zone of the carborundum furnace, just outside the crystalline silicon carbide, is a thin layer of an amorphous substance, known as "white stuff." It is an intermediate product in the formation of carborundum, and the temperatures between which it is formed and decomposed apparently lie near one another. For this reason its manufacture, or that of like compounds, involves serious difficulties, and it was to overcome these that Acheson invented this furnace. The furnace is of the same general form as that used in the manufacture of carborundum, but it contains several cores, which are "definitely spaced with relation to each other at distances largely determined by the heat conductivity of the charge, the duration of the operation and the superior and inferior temperature limits of the operation."[1]

In all of the furnaces described above there is one common characteristic—the electrical resistance is a variable quantity, and after any furnace is started there are no means of adjusting internal conditions so as to effect regulation in this respect. In general, the resistance of these furnaces is high at the beginning of a run and low at the end; therefore, means of varying the voltage at the furnace terminals must be used. The resistance of the furnace may be varied by altering the dimensions of the core or that part of the furnace which acts as an electrical conductor. There are limits to the variations that can be made in this respect on account of other considerations; but the resistivity of a mass of carbon granules varies with the size of the latter, and further variation may be obtained by the judicious choice of different forms of carbon, which themselves have different resistivities. By taking advantage of this, any desirable variations in the resistance of the furnace may be obtained. The case of the electrode furnace is a special one, the adjusting of the resistance being obtained, to a certain extent, by the spacing between the piles of electrodes.

The paper then proceeds to develop equations involving the various variable factors, from which deductions are made as to the practical limits of improvement in furnace regulation.

In no case considered are the various fundamental equations rigorously applicable, for these involve numerous assumptions that do not represent the actual conditions, and take no account of certain conditions that are invariably present. Nevertheless, by keeping the theoretical considerations in view a great help will be obtained in the building of furnaces, and waste of time prevented in experimenting with designs that cannot possibly be satisfactory.

[1] U. S. Patent 723,631, March 24, 1903.

Niagara Power Notes.

A new transmission line from the plant of the Niagara Falls Hydraulic & Manufacturing Company to the new plant of the Carter-Crume Company, at the north end of the city, has just been completed, and 150 hp of current sent over the wires. The Niagara Falls Hydraulic & Manufacturing Company has available for sale at the new industrial center in the north end 2,000 hp of current, and this amount will be greatly increased on the completion of the new power station. The pole line carrying the wires is one of the best in the country, the work being excellently done, with the poles of red cedar brought from Idaho. The turning on of the power brings into service the new generator and switchboard in the Hydraulic Power Company's plant. This switchboard is a good example of completeness and was designed and built by Engineer Harper and his assistant, Mr. B. F. Lee, who is in charge of the electrical features of the plant. The generator, built by the Bullock Electrical Manufacturing Company, of Cincinnati, is a 1,000-kw, 11,000-volt machine of three-phase, alternating-current variety, and the first of the kind installed at Niagara. Westinghouse transformers are used on this transmission line. The underground cables are the work of the National Conduit & Cable Company, of New York.

The new transmission line required no experimenting or testing. There was not so much as a flash when the current was turned on. More current will be sent to the Carter-Crume plant as soon as the remainder of the machinery is installed in the new works and the entire plant in operation. Great significance attaches to the transmission of power to the north end, and that section of the city will, without doubt, soon be converted into a teeming factory center.

Options are now being obtained on a right of way for a double-track electric railroad from Buffalo and Niagara Falls to Toronto, over which the largest type of electric cars will travel at a high rate of speed. A number of wealthy Canadians are interested in the project, and it is expected that negotiations will before long be completed with one of three electrical companies for furnishing power to the new road. At present a lively competition exists between the three interested companies. It is planned to construct a road paralleling the Grand Trunk.

Direct Cable to the Azores.

The German cable steamship *Von Podbielski* arrived at New York on Sunday last from the Azores. She will lay the shore end of a new cable from Coney Island to a point 110 miles out at sea for the North German Sea Cable Company.

Illinois State Electrical Association.

The Illinois State Electrical Association convened at St. Louis Saturday morning, September 19, at the Southern Hotel, and it was found that Secretary H. E. Chubbuck, general manager of the Illinois Valley Traction Company, La Salle, Ill., had made arrangements for a very enjoyable meeting. A special car was in waiting at 9.45 to take the thirty-five central station and street railway men, who convened, to the World's Fair grounds, where carriages were taken for a drive around the place and for a call on President Francis. Few had realized the extent of the undertaking before this visit. After returning to the Southern for lunch the party took the Illinois & West Shore Fish Commission steamer *Illinois*, which was specially chartered for the occasion, to Alton, and on Sunday, August 20, resumed the voyage, going as far as Beardstown. No papers of any kind were read, but the outing was both enjoyable and profitable to all the central station men participating. None but members and representatives of the technical press were invited, as the steamer accommodations were limited.

Wireless Telegraphy on the "Erin."

The De Forest Wireless Telegraph Company has forwarded us a summary of the work done for Sir Thomas Lipton, on board his steam yacht *Erin*, during her stay in American waters. During the 73 days that the yacht was in New York waters, it is stated, almost constant communication was maintained with the De Forest stations at Coney Island, State Street, New York City, and Block Island. The bulk of the matter transmitted was personal correspondence of Sir Thomas Lipton, and comprised 2,000 individual messages, footing up a total of over 40,000 words; and, in addition, 130 cables, all in code. During the most of the *Erin's* stay the Associated Press and Publishers' Press had a reporter on board, and a total of 10,750 words were transmitted for the press, for which a collection of $25 per day was made. The average length of a message was twenty words and frequently a message ran as high as ninety words. To transmit this bulk of business, it was necessary to send at an average speed of thirty-two words per minute. Sir Thomas was highly pleased with the service rendered, as shown in a letter to Dr. De Forest on the subject.

Indiana-Ohio Independent Telephone System.

At a conference held in Indianapolis, Ind., September 11, between Mr. Max Reber, vice-president of the Federal Telephone Company of Ohio; Mr. M. B. Overley, general manager of the United States Telephone Company, of Ohio, and Mr. S. P. Sheerin, president of New Long-Distance Telephone Company of Indiana, arrangements were made and contracts signed to build and connect up what is to be known as the Indiana-Ohio system. Connection will be made at Richmond with a line being built from Richmond, Ind., to Dayton, Ohio. Connection will be made at two other points further north in the two states. These connections will constitute a system that will give excellent service with all the towns and cities of Ohio, and as far east as Pittsburg. This far-reaching arrangement will in turn give Ohio people access to all of the Indiana telephones and a greater part of Kentucky, and all prominent points as far west as St. Louis.

Electrical Men at Export Club Dinner.

The Export Club of America, recently organized, had a dinner September 9 at its rooms, 9 South William Street, at which several electrical men and their friends were present. The club rooms were elaborately decorated for the occasion with electric floral lamps. About 100 covers were laid.

Among the diners were Conrad Hubert and J. H. Alvin, of the American Electrical & Novelty Manufacturing Company; Elmer P. Morris, of the Elmer P. Morris Company; J. Jones, Jr., of Jones & Son, etc. The club now has about 250 members. The list includes the names of William Angevine, of the Johns-Manville Company; F. C. Joutras, of W. M. Sheehan & Co.; Arthur Organ, of the Jandus Electric Company; H. L. Shippy, of John A. Roebling's Sons Company; Frank G. Bolles, of the Bullock Electric Manufacturing Company; W. H. Chapman, of the Northern Engineering Company; C. W. Farr, of the Farr Telephone & Construction Supply Company; A. C. Fletcher, of the Ohio Electric Works; A. J. Jupp, of the Lunkheimer Company; N. G. Lyman, of the Peerless Rubber Company; W. F. Malloy, of the Bridgeport Brass Company; C. J. Markham, of the Cleveland Twist Drill Company; F. L. Merritt, of the Standard Pole & Tie Company; Henry G. Pierson, of Foote, Pierson & Co.; I. M. Post, of Stanley & Paterson; F. C. Ayres, of the Jeffrey Manufacturing Company; Saxton Brown, of the Weston Electrical Instrument Company; W. J. Carr, of Carr Brothers; A. T. Compson, of the Rumsey Pump & Machine Company; William H. Frothingham, of Browne & Frothingham; H. C. Gable, of the American Steel & Wire Company; D. J. Gibson, of the Worthington Pumping Engine Company; S. S. Gould, of the Gould Manufacturing Company; William M. Pratt, of the Goodell-Pratt Company, and A. W. Richards, of Manning, Maxwell & Moore.

CURRENT NEWS AND NOTES.

MUNICIPAL OWNERSHIP FAILURE.—A special telegram from Valley City, N. D., says: The city council has decided to offer the electric light plant for sale. A twenty-year franchise will be given the purchaser. There are about 3,000 commercial lights on the system, and it is said to be the largest plant, outside of Fargo and Grand Forks, in the State. It has not been a paying investment for the city, and the expenses for the past year were about $7,000 more than the receipts.

THE VALUE OF TACT.—An excellent paper was read by Mr. John W. Ferguson, of the Chicago Edison Company, at the last meeting of the National Electric Light Association, on "Tactful Relations with Customers," a subject of great importance to all public service companies. While the paper was addressed primarily to those concerned with electric lighting, it contained so many valuable suggestions of general application that the American Telephone & Telegraph Company has distributed copies of the paper among its employees in all parts of the country.

LARCENY OF STREET CAR TRANSFERS.—Detectives of the Chicago City Railway Company long wondered why John Peats (colored), who has a news-stand at Thirty-first Street and Cottage Grove Avenue, sold more papers than any other boy in that neighborhood, and that most of the people who took cars at that point patronized him. They solved the problem recently when they discovered that Peats sold a street car transfer and a morning paper for five cents, and that conductors in collusion with him kept him supplied with transfers. His profits on the transfers, it is said, were divided with the conductors.

POWER OF RADIUM.—As noted already in these pages, Mr. Edward D. Adams, of this city, has presented to the New York Natural History Museum a tube of radium of 300,000 power. This was secured through Dr. George F. Kunz, the gem expert of Tiffany's, where, as well as at the Museum, some most interesting experiments have been made on precious stones and crystals, including the new Kunzite, to which a special article was devoted in our last issue. Working in experiments together, Dr. Kunz and Dr. Charles Baskerville, of the University of North Carolina, believe they have made a valuable discovery in connection with willemite. By mixing radium with natural willemite, pulverized to a powder, the activity or power of the former substance is multiplied a hundredfold, and probably—for no instrument has been devised for measuring the increase of the activity—a thousandfold. That, at least, is the temporary effect of the mixing of the two substances. Time must tell whether one will nullify the other. Willemite is a comparatively cheap silicate of zinc. It is possible, also, that there is in willemite a substance which is as yet unrecognized as a distinct element, but which produces the radioactivity that has awakened the enthusiasm of the two experimenters. But thus far it is taken for granted that the one substance merely stimulates the activity of the other. The germ of a very valuable discovery seems to lie here. Mr. Adams has now supplemented his previous generosity by authorizing Dr. Kunz to secure some radium of not less than 1,800,000 activity, which will probably be placed at the disposal of some of the hospital authorities for experiments on the alleviation or cure of disease.

ZOSSEN HIGH SPEED.—A cable dispatch from Berlin, of September 18, says: "In experiments made with an electric car on the Marienfelder military railroad to-day, a speed of 106 miles an hour was attained. It is hoped that eventually the cars will attain a speed of 200 miles an hour." A later dispatch states that 114 miles has been maintained for two miles.

WIRELESS MESSAGES.—*Le Figaro,* of Paris, is congratulating itself on the prediction it made two years ago that one could soon communicate with passengers on Atlantic steamers without leaving the boulevards. Last week the Compagne Generale Transatlantique distributed booklets giving the directions necessary for utilizing this mode of correspondence.

TO STUDY AMERICAN TROLLEYS.—Sir David Barbour, Lord Ribblesdale, George Gibb and Sir J. Dickson Poynder, members of the royal commission of London street traffic, appointed to study the American street railway system, sailed for New York on September 18 on the White Star line steamer *Arabic.* They will collect evidence on the subject while here.

WIRELESS TELEGRAPHY AT NEWPORT.—The naval wireless telegraph apparatus at the torpedo station at Newport, R. I., is now in working order. Communication is had with the station at Montauk Point, a distance of forty-five miles; and on several occasions communication was had with the ships of the North Atlantic squadron off Wood's Hole and while they were going to New York. The pole at the torpedo station is 168 feet above high water, and is situated on the west side of the island, facing the entrance to Narragansett Bay. There are now at the station six men under instruction, who are to be transferred to the various ships after they have become proficient.

SANDY HOOK BUOYS.—The electric buoy station at Sandy Hook was closed last week, gas buoys having been substituted for the nine electric buoys which marked Gedney Channel and Southwest Spit. The three lighthouses on Sandy Hook which have used electricity have returned to the old style oil lanterns. It is understood that electric buoys have never been fully satisfactory to the lighthouse establishment, owing to their frequent interruption through broken cables and other derangements. The buoys have not only been collided with frequently in summer by vessels, but in winter are subject to the assault of heavy ice floes. It will, however, be interesting to see what can well replace them.

COLORING DIAMONDS.—A special telegram from Chicago says: Predictions of a time when the brown diamonds in the crown of King Edward, the Hope diamond and other famous gems of the kind can be practically duplicated at will were made to-day by W. C. Fuchs at a Chicago X-ray experiment station. Mr. Fuchs announced the discovery of a process by which he is able to change a diamond to any color chosen and make such coloration permanent by the use of the Röntgen rays. The method consists in directing the X-ray through the substances from which the color is to be obtained before the rays touch and penetrate the diamond. Various metals and chemicals have been used to color the diamonds and it has been found that by reversing the method the color may also be removed. It is thought by Mr. Fuchs that when he has completely perfected his experiments he will be able to bleach yellow diamonds with ease.

ENGLISH WEATHER PREDICTIONS.—Professor Willis L. Moore, of the United States Weather Bureau, who has been attending the sessions of the International Meteorological Committee, spent several days in London before going to Paris to be the guest of M. Mascart, head of the French meteorological service. "This was the first time the United States had ever taken part in these conferences," he said in an interview. "The English meteorological service is doing magnificent work with a public grant that is extremely small compared with ours. It will always be handicapped in its efficiency by the great ocean lying to the West, and on that account will never be able to do what for a long time we have been doing in America. There we have three thousand miles of territory stretching east of the greatest storm frequency—that is twice daily—under meteorological survey through the medium of the telegraph and of our 180 observations. We, therefore, are able to view the inception and operation of a storm two or three days before it reaches the populous sections of our country, while here the only premonition they get is from the falling barometers at the coast stations when the storm is almost upon them."

LAYING ALASKAN CABLE.—In spite of previous troubles in laying and maintaining Alaskan submarine cables, the United States cable ship *Burnsides* sailed for the north last week to continue the work of laying the cable from the head of Lynn Canal by way of Sitka, the capital of Alaska, to Seattle. She has 600 miles of cable aboard, which was transferred from the steamship *Texan,* which brought the cable around the Horn from New York. On board the *Burnsides* were Gen. A. W. Greeley, chief signal officer of the United States Army; Colonel James Allen, of the Signal Corps, under whose general supervision the line will be laid; Captain Edgar Russell and Captain George O. Burnett, of the Signal Corps; Henry Winter, cable engineer, and Lieutenant Charles P. F. Chandler, of the Quartermaster's Department. Captain A. H. Laffin is in command of the vessel. The *Burnsides* will proceed direct to Juneau, whence, after making a short-line connection, she will leave for Sitka, paying out about 250 miles between the two towns, and continuing south from the capital by the open ocean, as far as the cable supply will reach, possibly to a point off Queen Charlotte Isle. It is expected that the entire consignment of cable on the *Burnsides* will be laid and the vessel be back in port for the final link by October 15.

LIGHT AS TORTURE.—A special cable dispatch to the new York *Journal* has this rather extraordinary yarn about torture in Russia: "Russian refugees now in Berlin relate a fresh form of torture devised and practised on political prisoners confined in the terrible Schlusselberg fortress. They assert that the brains of Russian political prisoners are permanently injured by long exposure to the rays of violet light. The subject selected for the scientific torture is placed in a large cell in which there are many windows. The sunlight streams in through violet panes. By night the glare comes from electric light. Day and night the violet rays are poured on the prisoner, sleeping or waking, until everything looks violet. His food and even his flesh is affected by the treatment. The scientific cruelty produces irritation, ultimately causing a change in the structure of the brain. The power of consecutive thought disappears. The sensory impression cannot be orderly arranged. The victim is not insane, only stupefied mentally. He performs the simple acts of life, but his intelligence runs low, to the verge of idiocy. Frequently the victim never recovers. He might be released without peril to the Government. While the red rays madden, the violet rays produce an incurable brain lassitude. There is no proof that all the political prisoners of Schusselberg are treated thus. Who and what prisoners are subjected to this new scientific torture remains a secret."

LETTER TO THE EDITORS.

Short Circuiting Through Electrolytic Action.

To the Editors of Electrical World and Engineer:

SIRS:—An interesting matter recently came to my notice which may be of interest to those of your readers who are engaged in electrical contracting or construction. A large slate panelboard was installed in a new building in New York City, the parts consisting of copper bus-bars, leads, switches, etc. The screws securing the parts were of iron, the heads being set in countersunk holes and the holes well cemented over with sulphur. The board was supported inside a wooden panel box (closet) against a newly-built brick wall in the cellar.

A few weeks after the board had been put in place, the installation became troubled with "grounds," both on the insulated conductors on the board, and between different branches separated by the slate which held them. An investigation showed that the slate did not carry a vein of iron or other metal. On removing the board from its box, it was found that the sulphur which cemented the countersunk screw holes had disintegrated and formed "streaks" downward across the points supposed to be insulated from each other. These streaky spots were found to be feeble conductors of current, and the holes from which the streaks emanated gave the odor of sulphuric acid.

It would seem that there are but two explanations of this unlooked-for and annoying effect of electrolysis, for such effect it

seems to have been. First, water pure and simple from the moist wall first penetrated the wooden back of the panel closet saturating it; the moisture was then absorbed by the pores of the slate and by the sulphur in the holes until it came in contact with the iron screws, thus making a "ground." The feeble current resulting electrolyzed the substance in the wood, thereby liberating some compound capable of attacking sulphur with liberation of hydrogen, and this hydrogen formed with the sulphur a hydrogen compound which slowly trickled down to a screw of opposite polarity, there undermining the sulphur which protected the head of the same, and forming a decided short-circuit. It was noticed that a number of the screw heads had been eaten off by the action, which might have been due to a formation also of sulphuric acid. Second, the effect might have been aided by something in the water coming from the brick wall, possibly a dissolved lime salt from the moist mortar in or around the bricks, together with a part or whole of the above-suggested components. So bad was the ground that every one of the four fastening bolts were in connection with one of the main copper feeders. It was also noticed that the copper had been slightly attacked with the formation of one of the green or blue copper salts, such as the sulphate, carbonate or hydrate.

It is evident that such a cement as sulphur is not "just the thing" under like circumstances, and it would be desirable for some one who has the opportunity to make a scientific examination of the actions I have observed, and present the results to the public.

NEW YORK. E. C. HANDY.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compensation of Asynchronous Motors.—MEYER.—An article in which the author investigates whether the main advantages claimed by the advocates of compensated (Heyland) induction motors, viz.: unity power factor at all loads, greater overload capacity and higher all-around efficiency, can be realized in practical operation and if so, at what cost. As far as the unity power factor at all loads is concerned, the author states that it is a "practical" impossibility to obtain it since the wattless current of induction motors is not only determined by the magnetizing current, which is approximately constant, but also by the leakage, which varies in direct proportion with the load. This claim could only be realized by continually varying the brush position, or changing the exciting voltage with the load. With a constant exciting current as required for practical operation, it is possible to obtain unity power factor for only one load. Considering that a power factor of 0.99 means as much as 14 per cent. wattless current, and a power factor of 0.98, 20 per cent., it will be seen that even with compensated or over-compensated induction motors, the system cannot be freed from wattless currents. The author states that undoubtedly the power factor throughout the total range of load is improved by compensation; but when comparing it with that of a modern well-designed induction motor, it seems that in most cases the difference would be hardly large enough to give such an importance to this claim as to outweigh all the disadvantages introduced thereby. In regard to the greater overload capacity, the author admits that the rotor flux in the compensated motor will be larger by about 8 to 14 per cent. at full load and unity power factor. At overloads, however, leakage will be present, and, therefore, the difference will not be so marked; nevertheless, the advantage of greater overload capacity due to the larger rotor flux would in most practical cases be only apparent, since the output of the motor is almost entirely limited by the efficiency and the heating, and in these points the compensated motor can hardly give increased figures when compared with the standard type. He next discusses in detail the claim that in compensated motors the reduction of leakage is no longer of prime importance, which would prevent such modifications as a longer air-gap, a smaller diameter and greater length, a lesser number of slots in the rotor and a more economical shape of the slots; all these points, in his opinion, are only of secondary importance in regard to leakage and are also available for standard induction motors as far as they are not objectionable for other reasons. The question of efficiency is then taken up at some length, the losses introduced by the contact resistance of the brushes and the question of friction losses being considered. To give an idea of the amount of losses from brush friction, the author gives the results of a test of a 9-hp induction motor, which took 290 watts with the carbon brushes on the slip rings and 150 watts when the brushes were taken off. A comparison with the squirrel-cage motor would show still worse for the compensated motor, as there the losses due to the end connections and all of the brush losses are entirely eliminated. In conclusion the question of the commutator and the various accessories, which enable the transformation of voltage and frequency necessary for compensation, is taken up, and the author concludes that these accessories must increase the cost of the compensated motor to such an extent that a commercial competition with the ordinary motor seems out of the question, the more so as the buyer would sacrifice simplicity and reliability, if not also efficiency, to gain only a few per cent. in power factor. The author states as the summary of his considerations that in his opinion there are hardly any practical cases where the compensated induction motor in its present form could be preferable to the ordinary induction motor, and that as long as the commutator is not used for improving either the starting conditions or for obtaining a more efficient speed regulation, it will find no field with alternating-current motors and "compensation" will remain only a pretty idea.—Lond. *Elec.*, September 4.

Variable-Speed, Polyphase Motors.—BURKARD.—The author reviews the methods of speed regulation of polyphase motors, subdividing them under three headings: 1, regulation by changing the poles in the stator; 2, by resistances in the rotor, and 3, by changing connections with coaxial stators, wound for a different number of

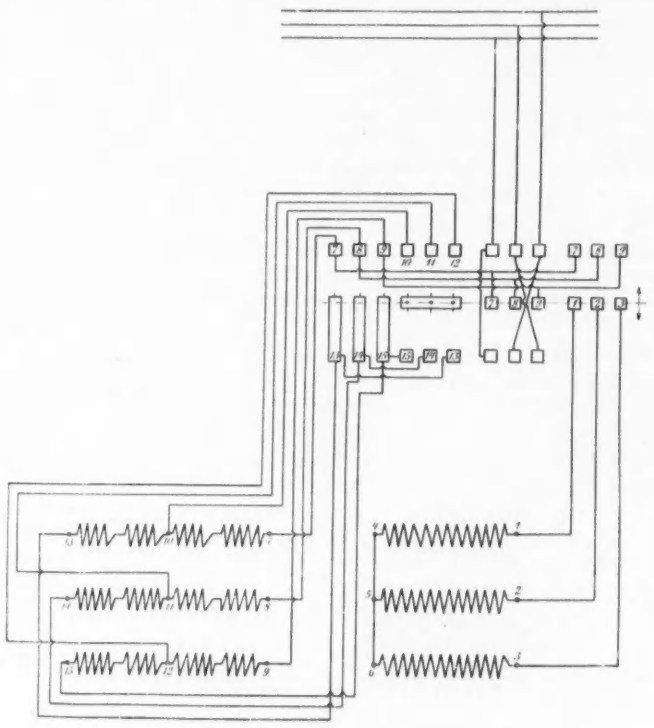


DIAGRAM OF CONNECTIONS.

poles. The greater part of the article is devoted to the third division, the motors of which consist practically of several motors on the same shaft; each of these he calls an element. The advantages of such a compound motor, called step-motor, are enumerated. A three-step motor of 4, 6 and 8-pole elements of 3 hp each, is illus-

trated, and the efficiency and power factor curves for each element are given. The 4-pole element has a torque corresponding to 2.9 hp, the 6-pole element one of 3 hp and the 8-pole element one of 2.8 hp, each at 400 volts and 50 cycles. It is stated that the winding of such a motor is very simple, and in case of damage to one winding the work in hand can be continued with the others. With a two-step motor three speeds and different effects can be obtained. For instance, a motor with 4 and 8 elements, each element wound for 3 hp, has speeds of 750 and 1,500 revolutions at 50 cycles. If the 8-pole element is connected to give 4 poles, there are furnished 6 hp at 1,500 revolutions. By connecting in parallel the normally 4-pole element with the one connected to give 4 poles, there are obtained 9 hp at 1,500 revolutions, and when the 4-pole element is connected to 2 poles, 3,000 revolutions are obtained. The adjoining figure shows the arrangement of the connections for the above 2-step motor. A 15-hp, 2-step, slip-ring motor built after the same principle, with 4 and 8-pole winding, is also illustrated in diagrammatic cross-section. Another motor designed for use on a large lathe is illustrated which has four steps, and by means of which eight different speeds are obtained, thus dispensing with the speed cone on the lathe. The motor is wound for 2, 4, 6 and 10 poles, and delivers 5 hp at 500 volts and 25 cycles. Some further experimental data with a normal three-step motor of 3 hp are given.—*Elek. Zeit.*, August 27.

REFERENCE.

Design for a 2-hp, Self-Starting, Single-Phase Induction Motor.—An illustrated description giving all the essential features of a self-starting induction motor capable of giving 2 brake horse-power on a single-phase circuit of 100 volts and 125 to 133 cycles. The speed will depend upon the frequency of the supply current; the actual full-load speed will be about 2,300 r.p.m. at 125 cycles and about 2,640 r.p.m. at 133 cycles. The illustrations are all dimensional drawings and the article contains all the information necessary for the building of the machine.—*Amer. Elec.*, September.

POWER.

Electric Power for Toronto.—An article containing abstracts of two reports made to the city engineer of Toronto on the estimated cost of developing electric power at Niagara Falls and transmitting it to and distributing it within the city. The first report assumes that power would be delivered at the city limits by a transmission line, as three-phase, alternating current at from 30,000 to 60,000 volts, and 60 cycles frequency. From the terminal station power would be distributed as three-phase, alternating current of suitable voltage to the various sub-stations. A total estimate of the power required amounts to a maximum of 13,750 kw, but not likely to exceed 10,000 kw. The capital cost of the total equipment for the various stations is given in detail and amounts to a total of $1,785,641. The total annual expenses are figured out at $283,955. If the current be delivered at 30 or 25 cycles, approximately $150,000 must be added to this sum for the apparatus to raise the frequency to 60 cycles in order to operate incandescent alternating-current lighting and street lighting. The second report deals with the transmission line from Niagara, which at 20,000-kw capacity is estimated to cost from $700,000 to $1,000,000. Assuming a figure of $10 per hp at Niagara Falls, the maximum cost per horse-power at the city limits is calculated at $18.96 and the minimum for the full capacity of the line at $15.23. The cost of power distribution per annum is estimated at $283,955. The total cost of power distributed is calculated at $38.16.—*Canad. Elec. News*, September.

Electrically-driven Mining Plant.—Hooghwinkel.—The author deals mainly with the application of electricity for drilling. He first sums up the advantages of the air drill over hand labor and then dwells upon the advantages of the electric drill over the air drill. The disadvantages of the air drill are: Deafening noise of the exhaust air, no power to draw back the drill when jammed in the bore hole, large amount of power required (about four times as much as with the electrical drill) and large amount of space required. The whole system is in fact disadvantageous on account of its cumbersome pipes, losses in the piping, inefficiency and heavy capital outlay required. Electrically-driven drills have none of these disadvantages. Each drill requires only 1 to 2 hp, according to its size, the working parts are few and any kind of bit can be used. The author then mentions two types of drills of the reciprocating percussion type. He states that the solenoid drills were never a commercial success, principally because they became too hot after a two-hours' run, and had to be exchanged. The percussion drill receives its power from a 1 to 2-hp motor by means of a high-speed revolving flexible shaft. The machine is simple in construction and strikes a blow of over 200 pounds 400 to 500 times a minute. The author is of the opinion that three-phase current of 120 volts is the most advantageous to use, with a transformer connected to the motors by flexible cable on a reel. If the reel runs out the transformer is moved on, and a length of high-tension cable is permanently put in. The output of electric drills is stated to vary very much with the number of revolutions of the motor, and it is, therefore, essential to keep the motor speed as constant as possible; as a rule, 5 per cent. being the limit for pressure variations allowable at the working face. The author claims that as a good average with skilled men the following output can be obtained: In granite, ironstone, etc., 4 in. per minute; in coal, hard sandstone, hard limestone, shales, etc., 8 in. per minute; and in sandstone and soft iron ores, 16 in. per minute. He states that he drove a 6-ft. roadway in a Luxembourg iron ore mine at the rate of 150 yards a month.—Lond. *Elec.*, August 28.

Electricity in Railroad Repair Shops.—An illustrated description of the electrical equipment of the Central Railroad shops at Elizabethport, N. J. The electrical equipment at present consists of three 110-kw, direct-current, 230-volt generators, but two larger units will soon be installed. Power is distributed by electric current through concrete tunnels running beneath all of the buildings and connecting them with the power plant. Special sets of mains are provided for light, for operating the motors in connection with the heating system, and for the operation of machine tools in each of the buildings. There are at present in use 110 electric motors, ranging in size from ½ hp to 30 hp, and having an aggregate capacity of 1,013 hp; other motors are being constantly added. Nearly all of the tools are motor-driven, some of them by motors attached to the frame of the tools and others by a motor-driven countershaft. With the exception of small tools which are intended to be used as floating tools, being taken to the work by the crane, any tool requiring 3 or more hp to operate it is provided with its own motor. Tools requiring less power to operate them are arranged in groups. Locomotives and tanks are handled in the erecting shops by means of two 50-ton cranes, each having an auxiliary 5-ton hoist, so that when not employed in handling engines they can be used continually for transportation of articles through the shops. This is considered an advantage over using one 100-ton crane and is a result of the longitudinal system of transfer. With the transverse system a 100-ton crane would usually stand idle about 85 per cent. of the time and would also require constructional accompaniments twice as strong as for the longitudinal system. A double trolley transfer table having a run of 800 ft. at the rate of 300 ft. per minute is used to connect the various buildings, being operated by means of two direct-current motors with series-parallel control.—*Amer. Elec.*, September.

REFERENCE.

Electric Power in Steel Plants.—Perkins.—An illustrated description of the details of construction and arrangement in a large German steel mill.—*Elec. Rev.*, September 5.

TRACTION.

Tangential Traction.—Guarini.—An article containing a description of a new system of electric traction, invented by Rosenfeld and Zelenais. The most characteristic feature of the system is the absence of the rotating motor in the car, and of any connection between the vehicle and the source of electrical energy. The stator of a polyphase system is developed along a plane surface and fixed between the rails on which the vehicle travels. The rotor, similarly developed, is suspended under the vehicle. The latter will then be put into horizontal motion when a polyphase current is sent into the fixed part of the system, the stator. Under these conditions the magnetic field no longer revolves, but travels along. This principle, however, cannot be applied practically under ordinary conditions, owing to the necessity of keeping the air-gap small. The inventors have, therefore, devised an arrangement by which they were enabled to increase the air-gap while retaining the same reluctance. Instead of enlarging the whole of the core they enlarge it at only the poles by means of sheet iron laid transversely, the core itself being laminated longitudinally. By this method the winding round the core retains its original length, and the surface of the air-gap can be increased to the extent required in order to keep the reluctance the

same. In order to supply the normal tractive effort, it is sufficient to have stators occupying only a small fraction of the length of the track. In order that the action of the stators on the rotor (called propeller) may be continuous, notwithstanding that they are discontinuous, the length of the propeller must be equal to or a little greater than the distance from center to center of the stators. The entire length of the track is divided into sections of suitable length, each containing one or more blocks of stators. All the stators in one section are connected in series; the three wires of the three-phase winding of the first stator in each section are connected with the distributors placed along the track, and the three ends of the last stator winding are connected with the contact blocks of an interrupter. When this interrupter is closed the three ends of the winding of the stators are connected together and form the neutral point. The stators are then traversed by the three-phase current. When, on the other hand, the interrupter is open, the neutral point of the three-phase winding of the stators is broken and the current no longer passes through. In order that a group of stators may be traversed by the current only when the train is passing through this section, the interrupter must close automatically at the moment that the train enters the section in question and open again as soon as the train has left it. The opening and closing of the interrupter is effected by a small three-phase motor, connected between the rails and operated by the train as it passes over the tracks. The author states that he has seen the working of the system on a trial line 800 meters long, where the principal dimensions of the stators are as follows: Total length, 2.77 meters; breadth of the polar expansions, 0.5 meter; section of core, 0.25 x 0.16 meter. Their winding is of the ring type and the number of bobbins is 24, or 3 for each phase. The pressure chosen is from 1,300 to 2,000 volts. The propeller is 19.5 meters long, the distance between the centers of the stator being 18 meters. The winding of the propeller is based on the principle of the squirrel-cage winding. The special feature of the starting rheostat is that it can modify the individual resistance of each bar of the squirrel cage. The whole train weighed about 22 tons, and the propeller traveled on a small track inside the main track. The author then sets forth the advantages of this system of traction, of which he reveals himself an enthusiastic, optimistic advocate. The Ferraris prize of $3,000 has been awarded to the inventors of this system.—Lond. *Elec. Rev.*, August 21, September 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Practical Storage Battery Operation.—LIVERSIDGE.—An illustrated article in which the author urges the placing of the storage battery in the care of a competent electrician and not in the hands of an inexperienced dynamo attendant. There is no reason in the world, he says, why a storage battery if properly installed cannot give results which will come very close to those obtained from so-called laboratory tests. The storage battery will do almost any amount of hard work, provided it is kept in a healthy condition. A greater part of the troubles found in storage cells can be traced directly to improper charging. Three methods for charging a battery are described. During the time the battery is floating on the system considerable care should be exercised in order that the charge and discharges may be kept as small as possible. This applies particularly to batteries used on lighting circuits which are provided with end-cell regulation that the charge and discharge can be controlled as desired, irrespective of the load variations in the system. It is a common occurrence for batteries to receive considerable overcharge while supposedly lying dormant on the system. Practical operation has shown that to give the best results the average e.m.f. per cell for any discharge and corresponding charge, or series of discharges and complete charges, should be approximately 2.09 volts, for cells in good condition; it will rise slightly as the battery ages. In the discharge of batteries there are two points which should always receive attention, namely, the rate of discharge and the proper point of cut-off. The cells are designed to give a certain maximum output for some specified length of time, which in general practice is one hour. An excessive discharge rate is sure to weaken the plates. In station work, however, especially on incandescent lighting systems, the discharge may reach several times this value for a few minutes, due to some accident to the line or generating machinery. The e.m.f. at the end of the discharge is dependent chiefly upon the rate of the current flowing; battery manufacturers recommend that a cell should not be discharged below 1.7 volts when discharging at the normal rate. With a maximum discharge current flowing, this value may fall to 1.6 volt without materially damaging the battery, but for practical work 1.7 volt per cell is as low as safe operation will permit. Immediately upon the completion of a heavy discharge the battery should be put on charge. Under no circumstances should a battery be allowed to stand discharged, as the plates will immediately begin to sulphate, causing no end of trouble if allowed to continue. The storage battery is no exception to the general class of electrical apparatus with regard to repairs, so troubles of one kind or another must be expected. It is rarely the case that any trouble arises which will damage the entire battery; in any such event the cause is usually apparent. Frequently, however, individual cells in a series will require special attention, due to some local trouble which may develop. The author considers the most probable cases which are likely to arise in practical operation.—*Amer. Elec.*, September.

REFERENCE.

Hydro-Electric Installation at Rossy Priory, Perthshire, England.—An illustrated description of a hydro-electric plant for lighting a country residence. The water is brought to the turbines with 65 ft. head from a pond. There are two turbines, one on each side of a dynamo, so that one or both turbines can be run. A table of brake tests is given with a varying number of ports open in the turbines.—Lond. *Eng'ing*, August 28.

ELECTRO-PHYSICS AND MAGNETISM.

Radium Emanations.—A long, well-written editorial, reviewing the most recent work in this field. After considering the general fairly well established properties of the radioactive substances, reference is made to the work of Sir William and Lady Huggins on the spectra of the radiations, and their first communication to the Royal Society, in which they stated that some of the lines obtained appeared to agree with the helium lines, and that it did not seem impossible that helium was being liberated in connection with the active molecules in a state of molecular vibration. An addition to this communication was, however, made recently, for when the spectrum had been shifted very slightly with regard to the scale, the seven strongest lines would agree in intensity, character and position with the bands of the nitrogen spectrum. No cause for such shifting could be traced, but a movement through 1/150 in. was all that was required. All of the ultra-violet radiations seem to be due to nitrogen; whether atmospheric nitrogen or nitrogen occluded by the radium, is an open question. Attention is drawn to the bearing of this communication on the work of Sir W. Ramsay and Soddy on radioactivity and the production of helium from radium, recently referred to in the Digest, where six helium lines were distinctly identified in the emanations from 30 grams of radium bromide. Attention is drawn to the fact that nobody has as yet handled pure radium salt, and that spectroscopic tests are, from their very delicacy, not in themselves sufficient to establish what practically amounts to the conversion of one element into another. Reference is made to the work of Sir W. Crookes and Prof. Dawn on the effect of extreme cold on the radium emanation and to the work of Strutt on the penetrating power of the gamma-rays mentioned below in the Digest. The oxidizing action of radium rays as indicated by the decomposition of iodoform is being investigated by Hardy and Willcock. They found that the beta-rays seem to be particularly active in this respect, but as several layers of glass and lead did not stop the effect, the gamma-rays also appear to be concerned. Furthermore, the alpha-rays seem to change the physical state; they coagulate electrically negative colloids, and dissolve colloids charged positively; the beta and gamma-rays produce chemical changes and oxidize tissues. Without dwelling on the differences between Röntgen, light and radium rays, the authors suggest that the lethal effects of radium rays often noticed may be due more to their great power of penetration than to any novel or intense action. The speculative hypotheses with regard to radium, of Lagrange, Filippo Re and Sir W. Crookes are briefly mentioned in conclusion. Suspension of judgment is recommended, until a confirmation or refutation of the conversion of radium emanations into some other substance is coming forth.—Lond. *Eng'ing*, August 28.

Third Species of Radium Rays.—STRUTT.—An abstract of a paper presented before the Royal Society, England. The author examined the so-called gamma-rays or intensely penetrating radium rays, which up to now were supposed to be identical with Röntgen rays. He found that they agree with the latter in not carrying an electric charge, in photographic and screen effects, and in ionizing power;

but that they differ as regards their ionizing effects on various gases. This difference is so pronounced that the author feels justified in denying their identity with the Röntgen rays. He found a great difference; for instance, in the case of carbon tetrachloride and methyl iodide. The radium rays of all kinds obey a different law from the Röntgen rays and are probably all of a corpuscular nature. The supposition that the beta or cathode rays produce gamma or Röntgen rays by impact upon the radium itself, is unlikely, for quantitative reasons, since the current emitted in cathode rays by a square inch of intensely active radium is only 10^{-11} amp., whereas the current through a focus tube is of the order 10^{-2} amp.—Lond. *Elec.*, August 28.

On the Radioactivity of Metals Generally.—McLennan and Burton.—The authors in pursuit of their investigations previously referred to in the Digest, made further experiments on the radioactivity of ordinary metals. They found that when a cylinder of any metal is enclosed within a second of the same material, insulated from it, and surrounded by air and other gases, it gradually acquires a negative charge and after a short time reaches a state of equilibrium at a definite potential below that of the enclosing cylinder. So far the experiments made indicate that the negative charge acquired by the cylinder results from a process in which an excess of positively-charged corpuscles is expelled from its surface. This process is probably identical with the alpha radiation observed by Rutherford and others in the highly radioactive substances—radium, thorium and uranium, and experiments are now being made by the authors to determine its relation to the effect observed by Guthrie and others, that a metal like the platinum, for example, when heated to dull red, will discharge a negatively-charged body placed near it, but not one positively-charged.—*Phil. Mag.*, September.

On Resonance Coils.—Mizuno.—The conclusion of the article previously noted in the Digest. The author describes a large resonance coil, which he constructed and with which he obtained beautiful brush discharges. He then investigates mathematically the theory of the electrical oscillations in these coils. He arrives at two complicated equations, from which he deduces that the amplitude of the current possesses a series of maxima and minima, whose values are continually diminished in virtue of the presence of a hyperbolic function. The form of the current is, therefore, stationary in a restricted sense, the set of minima being never absolutely zero, except at the free end. He describes some experiments, with curves plotted from the results obtained, showing the quasi-stationary character of the potential vibrations corresponding to that of the current.—Lond. *Elec.*, August 21.

REFERENCE.

Electromagnets.—Guarini.—A note on a recent construction of an electromagnet, the difference from the ordinary type consisting in the manner of winding, the conductors being drawn through slots in the core. The manner in which the winding is carried out is illustrated. The author states that the carrying weight of an electromagnet of this construction, with a current of 4 amp. at 2 volts, was found to be 9,600 grams, as against 1,050 grams for the ordinary type.—Lond. *Elec.*, August 28.

Electro-Chemistry and Batteries.

Electric Steel Process.—Heroult.—An illustrated description of his researches in the electrometallurgy of iron and steel. He first describes his furnace in which arcs are struck between the ends of two carbon rods and the metal to be fused. For regulating the arcs, a piece of wire is provided in contact with the metal to be melted and connected to one terminal of each of two voltmeters, while the other poles are connected to the poles of the dynamo; each voltmeter is thus in shunt with one arc; all the regulation is automatic. This furnace was extensively used for making ferro-chromium; each charge is about three tons. The operation of obtaining steel from ores is divided into two steps; he first makes cast iron or pig and afterwards treats it in the steel furnace, the cast iron problem being solved by means of a special type of furnace. For making steel, a charge of scrap iron, mixed or not mixed with pig, is melted either in the steel furnace itself or poured into it in the molten state from a ladle or from a converter, etc., the principal condition being that the molten metal should be peroxidized and free from slag; it is then covered with an artificial slag and submitted to the action of the current which has no other object but to heat it without any intervention of flame or oxidizing agent of any kind. This enables him by pouring out the first slag and charging new fluxes, to wash out all the impurities of the metal; by adding carbon and other ingredients a perfect deoxidation is obtained; the best kinds of tool steels are thus made. About 1,500 tons have so far been made by this process, which is soon to be applied in connection with a large Thomas works where electric power will be generated by means of a blast furnace gas engine.—*Electrochem. Ind.*, September.

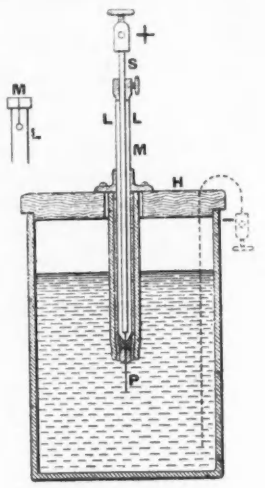
REFERENCES.

International Congress for Applied Chemistry.—Danneel and Clement.—The first part of a condensed report of the proceedings of the electrochemical section of the International Congress for Applied Chemistry recently held in Berlin. Brief abstracts of the following papers are given: Traube, an investigation of critical density; Nernst, the determination of molecular weights at high temperatures; Froelich, a new electric resistance furnace; Wedekind, colloidal zirconium; Moissan, metallic carbides; Marie, electrolytic reduction of unsaturated compounds; Foerster, electrolytic preparation of inorganic compounds; Le Blanc, electrolysis by alternating currents; Gin, electrometallurgy of aluminum; Zenghelis, chemical reactions at high temperatures and their industrial application; Goldschmidt, manufacture of iron and steel in the electric furnace. In the last paper details are given concerning the Kjellin process for making high-grade tool steels, which has been mentioned in the Digest. The report is to be concluded.—*Electrochem. Ind.*, September.

Italian Caustic Soda and Bleaching Powder Plant.—An illustrated description of the plant of the Societa Italiana di Elettrochimica, on the railway line between Rome and the Adriatic Sea; 6,000 hp have so far been developed. The diaphragm process of Outenin-Chalandre is used. In view of the unsettled state of the market for bleaching powder, a supplementary plant is being erected for the manufacture of chlorates, pure synthetic hydrochloric acid and carbon tetrachloride.—*Electrochem. Ind.*, September.

Units, Measurements and Instruments.

Renewable Wehnelt Interrupter.—Zehnder.—An abstract of an article, in which the author describes a renewable Wehnelt interrupter, illustrated in the adjoining figure. *M* is a brass tube containing the brass rod, *S*, to the lower end of which is fastened the platinum point, *P*. *LL*, is a lateral perforation of the tube, down to which it is slit, as shown in the figure, in oder to guide the rod, *S*, in its vertical adjustment. The lower end of the brass tube is closed by a steatite plug, which is perforated in order to let the platinum wire pass through. A rubber tube is slipped over the brass tube and over that again a glass tube is drawn, which presses the rubber tightly against the stone. With this arrangement the acid can do no damage, unless it penetrates through the steatite to the brass rod; this takes place only when the perforation gets widened, and when this occurs, the plug must be renewed. hTe negative electrode is a lead plate or a lead worm, cooled by cold, running water. As an additional precaution, the brass tube may be replaced by a copper tube covered with lead. The lid, *H*, is of wood, paraffined and lacquered.—*Annalen der Physik*, No. 10; abstracted in Lond. *Elec.*, September 4.



RENEWABLE WEHNELT INTERRUPTER.

Measurement of High Potentials.—Voigt.—An article in which the author describes a method by which he claims potentials of 100,000 volts can be measured to within 1 or 2 per cent. Difficulties begin at 50,000 volts, the problem being to keep the actual potential away from the measuring instrument, which must, of course, contain metallic points and lines, which are specially threatened by high voltages. It seems that a part of the voltage is measured by using a potentiometer rather than a condenser. The potentiometer scale consisted of a bar of maple wood embedded in an insulator. With a Holtz machine at 200 r.p.m., 60,000 volts could be attained. To get 94,000 volts 500 turns per minute of two disks were required, or five times the electric quantity. This shows the great loss by dissipation. It was found that errors introduced by the heating of the wood were negligible. The author applied the method to the deter-

mination of spark potentials in air and the potentials at which various insulators were pierced. With mica 0.2 to 1 mm. thick, 25,000 to 54,000 volts were required. Glass, 1 to 5 mm. thick required 40,000 to 90,000 volts.—*Annalen der Physik*, No. 10; abstracted in Lond. *Elec.*, September 4.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Automatic Block Signals for Railroads.—SCOTT.—A well-illustrated article describing electric automatic block signals. The author describes in detail the "normal clear" and "normal danger" signal systems. In the former system the blade, semaphore or disk is normally held at the "clear" or no-danger position; continuously occupying this position, unless the block which the signal protects be occupied or be otherwise dangerous. In the normal danger system, on the other hand, the signal is normally held at "danger," maintaining this position until a train approaches the signal, when, provided the block is clear, it will indicate "clear" and hold this position until the first pair of wheels crosses into the block; when the signal moves back to "danger." The battery of a "normal danger" system normally sends no current into the signal, while in the "normal clear" system the battery is normally discharging its full current. The "normal danger" system, on account of its cheapness of operation, reliability and almost entire elimination of false indications, has found greatest favor in practice with both disk and semaphore signals. Railroads require that a good system of signals should never indicate "clear" when "danger" should be shown, while it is considered of comparatively little importance if "danger" signal is up when "clear" should be shown. Long railroad experience has shown that the "normal clear" system is much more liable to false indications than the "normal danger." Moreover, records show that on a main line having trains running every ten minutes, the passage of these trains keeps the signals in operation on an average of 4 hours out of 24 in "normal danger" systems, and 20 hours out of the 24 in "normal clear" systems. This shows the relatively greater demand on the signal battery in "normal clear" systems. American railroads in general show a decided preference for the "normal danger" system on account of its great reliability under all conditions, the only causes of its showing false "clear" signals being mechanical, and these are readily eliminated by proper care on the part of the signal man. In the "normal clear" system nearly all cases of false "clear" indications are electrical and are generally hard to discover after a wreck or an accident has taken place.—*Amer. Elec.*, September.

REFERENCES.

Telephone Engineering.—DOMMERQUE.—An article dealing with telephone cables for aerial and underground construction. The author describes the method of making the various cables and also treats of the mechanical and electrical properties of the wire used in them. —*Amer. Elec.*, September.

Automatic Electric Railway Signaling.—ROSENBERG AND BALLIET. —A paper read before the Franklin Institute on automatic electric railway signaling and its purposes; also past and present installations. The paper first deals with the historical part of the subject and in the second part the authors discuss a number of the more recent devices.—*Jour. Frank. Inst.*, September.

New Books.

ELEMENTARE VOILESUNGEN UBER TELEGRAPHIE UND TELEPHONIE. Von Dr. Richard Heilbrum. Berlin: George Siemens. 164 pages, 45 illustrations.

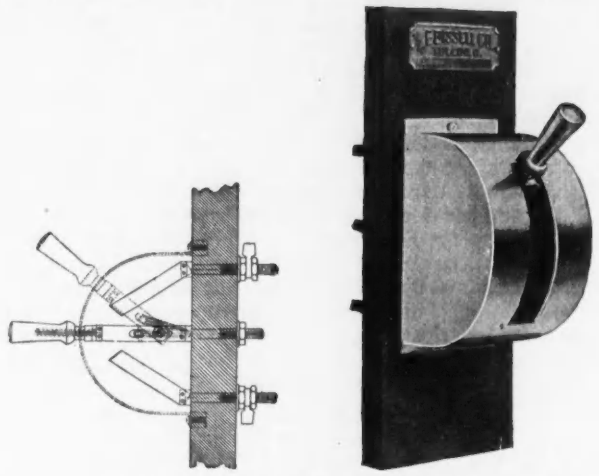
This pamphlet is the fourth part in a German text-book upon telegraphy and telephony. Part III ended in the middle of a description of storage batteries, so that the first dozen pages of the present issue are devoted to a completion of that topic. Then comes a description of the general laws of wave motion, in which the familiar sine curve and diagrams showing harmonics and overtones appear. The concluding chapter in this part is devoted to telegraphy and deals particularly with sounders and the various forms of apparatus for recording Morse signals.

BOOKS RECEIVED.

THE ALTERNATING-CURRENT TRANSFORMER. By F. G. Baum. New York: McGraw Publishing Company. 195 pages, 122 illustrations. Price, $1.50.

Theatre Switch.

A new theatre switch has been designed and manufactured by the F. Bissell Company, Toledo, Ohio. It is well made and prepared to stand the abuse which is unavoidable in the quick action always required in the manipulation of a theatre switchboard. The electrician has no time to handle a switchboard gently. When he snatches it open, or slams it shut, he must be sure of results.



FIGS. 1 AND 2.—THEATRE SWITCH.

The detailed cut shows how the blades spring into position, on each circuit or between them, and stay there. This can be done with the greatest rapidity, because when the blades are started they jump the rest of the way, and stop in position. A metallic cover conceals the flash.

Watchman's Time Detector.

The watchman's time detector, manufactured by the American Watchman's Time Detector Company, 47 Sheriff Street, Cleveland, Ohio, is designed to keep an accurate record of the doings of a night watchman. The instrument is placed in the office and connected by insulated wires to magneto stations in different parts of the premises. As the watchman passes these on his rounds he operates each station in turn, a record being made on the detector in the office, showing

WATCHMAN'S TIME DETECTOR.

where the watchman was at any time. The record is made on a paper dial 5, 12 or 20 inches in diameter (according to the number of stations), which makes one revolution during the night. The dial is operated by a Seth Thomas clock movement. The record is made by a series of needles, each punching a hole through the paper dial. The detector may be designed for any number of watchmen, and the company has built instruments keeping a record of fifteen watchmen on a single dial. Instruments are made for as many as 54 stations. The detector shows to a minute when the watchman visits the stations.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stock speculation continued dull and largely professional in character. Better crop reports caused recoveries in the railway list, but decided weakness developed in the United States Steel stocks, principally in the common shares on unconfirmed reports that dividends on them might be reduced or passed in consequence of slack business and decreased earnings. A heavy break occurred in Steel shares at the latter part of the week. On Friday common closed at 18 and dropped a point to 17 early on Saturday under a heavy selling. This is the lowest quotation so far recorded for this stock. The preferred declined below 68, while the bonds eased off to 74½. On Saturday there was heavy selling of industrial stocks, General Electric suffering a break of several points. This stock closed at 155, having touched 153½, the highest quotation being 161½. The net loss was 5½ points. Westinghouse common and preferred lost 15 points and 11 points, closing at 151 and 160, respectively. Western Union closed at 81¼, a net decline of ¾ points. American Telephone & Telegraph lost 1¾ points, the ruling and closing figure being 130¾. The transactions declined in sympathy with the general market, Brooklyn Rapid Transit closing at 37¼, being a loss of 3¼, and Metropolitan Street Railway at 111⅜, a net loss of 2⅞. Following are the closing quotations of September 22:

NEW YORK.

	Sept. 15	Sept. 22		Sept. 15	Sept. 22
American Tel. & Cable	78¾	79	General Electric	160	153
American Tel. & Tel.	130	127	Hudson River Tel.	..	..
American Dist. Tel.	24	24	Metropolitan St. Ry.	113¾	112
Brooklyn Rapid Transit	38¾	37¼	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	145	146	N. Y. & N. J. Tel.	..	..
Electric Boat	13	16	Marconi Tel.	1⅞	1¾
Electric Boat pfd.	38	40	Western Union Tel.	83	82
Electric Lead Reduction	1¼	1¼	Westinghouse com.	155	149½
Electric Vehicle	5½	4⅞	Westinghouse pfd.	160	160
Electric Vehicle pfd.	8	7			

BOSTON.

	Sept. 15	Sept. 22		Sept. 15	Sept. 22
American Tel. & Tel	131	128¾	Western Tel. & Tel. pfd.	80	80½
Cumberland Telephone	..	*115¾	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	..	230	New England Telephone	124	*124
General Electric	..	152½	Mass. Elec. Ry.	20	19
Western Tel. & Tel.	12	11½	Mass. Elec. Ry. pfd.	78½	78

PHILADELPHIA.

	Sept. 15	Sept. 22		Sept. 15	Sept. 22
American Railways	44½	43	Phila. Traction	95½	94½
Elec. Storage Battery	55	52	Phila. Electric	6	6¼
Elec. Storage Battery pfd.	55	..	Phila. Rapid Trans.	13¾	13⅜
Elec. Co. of America	8¼	8¼			

CHICAGO.

	Sept. 15	Sept. 22		Sept. 15	Sept. 22
Central Union Tel.	..	..	National Carbon pfd.	9	*90
Chicago Edison	..	..	Metropolitan Elev. com.	..	18
Chicago City Ry	170	170	Union Traction	5	4½
Chicago Tel. Co.	..	..	Union Traction pfd.	30	32
National Carbon	20	*20½			

* Asked

AMERICAN RAILWAYS' ANNUAL.—The American Railways Company has issued its annual report for the year ended June 30, 1903. We make the following comparison of the income account:

	1903.	1902.	1901.	1900.
Gross	$423,028	$370,384	$274,623	$144,081
Deductions	148,336	67,652	48,517	49,346
Net	$274,692	$302,732	$226,106	$94,735
Dividends	223,774	178,178	112,530	.....
Surplus	$50,918	$124,554	$113,576	$94,738
Previous surplus	330,865	206,311	92,735	.....
Total surplus	$381,783	$330,865	$206,311	$94,735

President J. J. Sullivan says in part: "Gross earning of the subsidiary companies were $1,245,298, an increase of $238,802 over 1902, or about 23 per cent. During the year the $910,000 5 per cent. collateral trust convertible bonds were disposed of at a price netting the company 98 per cent. and interest. In July, 1902, the Bridgeton & Millville Traction Company delivered to this company $150,000 first mortgage 5 per cent. gold bonds in part payment for its Port Norris extension. These bonds have been sold at par and interest. Since June 30, 1902, $52,000 5 per cent. collateral trust convertible bonds have been converted into stock. In September of 1902 the company sold 2,000 shares of unissued stock at par. This company now owns the entire capital stock of the People's Railway Company, of Dayton, Ohio. The total trackage owned by the American Railways Company is 217.1 miles, showing a gain for the year of 34.1 miles. While the growth of the property shows great improvement, the increase in the cost of labor, coal and electrical equipment has been a factor in keeping down profits."

DIVIDENDS.—Easton (Pa.) Consolidated Traction directors have declared a semi-annual dividend of 60 cents, payable September 24. The directors of the Hall Signal Company have declared the regular quarterly dividend of 1½ per cent. on the common stock, payable October 1. The directors of the American Telephone & Telegraph Company have declared the regular quarterly dividend of 1½ per cent. The directors of the Electric Storage Battery Company have declared the quarterly dividends of 1¼ per cent. on the common and 1¼ per cent. on the preferred stocks, payable October 1. Directors of Cleveland Electric Railway have declared a quarterly dividend of 1 per cent., payable October 5. This is the first dividend since the merger with the Cleveland City Railway, and establishes a rate of 4 per cent. The Cincinnati Gas & Electric Company has declared the regular quarterly dividend of 1 per cent., payable October 1. The Cincinnati Street Railway Company has declared a quarterly dividend at the rate of 5¾ per cent. per annum. A dividend of 2½ per cent. has been declared on the preferred stock of the Union Traction Company, of Indiana, payable October 1. The Chicago Metropolitan Street Railway Company has declared its usual quarterly dividend of 1¾ per cent., payable October 1.

CUTTING A BELL DIVIDEND.—The Bell Telephone Company, of Philadelphia, is to give notice to stockholders that the quarterly dividend to be paid in October will be 1½ per cent., instead of 2 per cent., as heretofore. An authority on the affairs of the Bell Telephone, of Philadelphia, says: "The reduction of the dividend was at the instance of the new Boston directors in the board elected last year, who believe that the company is expanding so fast that some of the earnings as well as the new capital should be used on the plant. The present action comes as a surprise to the minority interests, and it would seem that the management might have done better than to reduce the dividend, while the books remain open for subscription to the $2,000,000 new stock. The dividend is payable the latter part of October. The Bell system is by no means on a uniform rate, as some of the Bell companies are paying as high as 8 per cent. and 10 per cent. per annum." Secretary Pierson says: "The occasion for the cut in the rate from 8 per cent. to 6 per cent. is to make a uniform rate for the Bell companies. It maintains the stock on an investment basis." It is estimated that the gross earnings for the current fiscal year ending December 31, 1903, will increase $750,000.

WORK AT THE SOO.—Pending the outcome of the financial difficulties in which the Consolidated Lake Superior Company is now involved, President Shields has issued orders to close down temporarily all of the operations of the company except the street railway system on both sides of the river, the ferry system, and the Tagoma Light and Power Company of the Canadian Soo. This step is taken, it is announced, because the funds of the company are exhausted, and Mr. Shields does not want to incur further liabilities until it is known from where the money with which to meet them is coming. Inasmuch as the company's operations on the American side are confined to the street railway and the power house force, the order will not materially affect the American Soo. In the Canadian Soo, however, the effect on business will be very extensive.

CONSOLIDATION IN SALT LAKE.—It is learned that negotiations are practically completed for the transfer of the Consolidated Railway & Power Company's system to the Utah Light & Power Company. Approximately $6,000,000 is involved in the transaction, although half of this amount represents the bonded indebtedness of the company. The purchase will be made from A. W. McCune, and the transfer will be effected as soon as experts have made an examination of the books of the company. By this transfer the street railway system becomes the property of the Mormon Church. President Joseph F. Smith, of the Utah Light & Power Company, is president of the church and the other officers of the company are representatives of the church.

JERSEY CITY POWER HOUSE.—The North Jersey Street Railway Company, recently absorbed by the Public Service Corporation of New Jersey, has bought a tract of land on the Hackensack River at Jersey City for which it paid $12,500. The river frontage is 300 ft., the plot being 1,140 ft. deep at the north end and 935 ft. deep at the south end. It will be used for a new power house in connection with an extension of lines on the west side of Jersey City Heights contemplated by the Public Service Corporation.

CUMBERLAND TELEPHONE.—The Cumberland (Bell) Telephone system reports as follows: August gross, $281,013; expenses, $182,926; August net, $98,087; other income, $10,223; total net, $108,310; total subscribers, 93,378, a gain of 281 for the month.

ST. LOUIS LIGHTING DEAL.—The stockholders of the Missouri-Edison Electric Company and the Union Electric Light & Power Company voted to combine the two companies, to be known in the future as the Union Electric Light & Power Company. The vote of the Union Company stockholders on the consolidation was unanimous, while the vote of the Missouri-Edison Electric Company resulted in 35,175 shares being voted for the proposition and 1,272 shares against it. The consolidation of the two big lighting companies is, in reality, a mere technicality, as both are dominated by the North American Company, which recently purchased the Laclede Gas Light Company, and had previously bought the Missouri-Edison and Union Companies. The scheme is to consolidate all the electric light and power plants of St. Louis. It is said also that this same company has plans for uniting with its other properties the electric street railway systems of the city. The stock of the new Union Company will be $10,000,000, all common. Under the terms of the consolidation stockholders of the Missouri-Edison Company will receive one share of the new stock worth $100 and $5 in cash for two shares of the preferred stock of the Missouri-Edison Company. The same allowance will be made for four shares of common stock of the Missouri-Edison Company.

WESTINGHOUSE AIR BRAKE.—The annual meeting of the Westinghouse Air Brake Company will be held October 6 next. The report for the fiscal year ended July 31, 1903, compares with the two preceding years as follows:

	1903.	1902.	1901.
Net sales of brakes	$8,452,474	$7,890,831	$7,149,000
Other income	727,113	668,672	720,857
Total income	$9,179,588	$8,559,503	$7,869,857
Expenses	5,460,508	5,630,807	4,888,515
Net earnings	$3,719,080	$2,928,696	$2,981,342

The company charged off $25,506 for depreciation and set aside a special depreciation reserve fund of $300,000, leaving earnings applicable to dividends of $3,393,573. Dividends paid for the year $2,636,748. The surplus after dividends amounts to $3,993,869. The net sales for the past fiscal year were the largest in the company's history

BELL TELEPHONE OUTPUT.—The instrument statement of American Telegraph & Telephone for the month ended August 30 and since December 20 compares as follows:

	1903.	1902.	1901.
Gross output	63,565	84,279	81,144
Returned	46,136	43,034	42,997
Net output	17,429	41,245	38,147
Since Dec. 20:			
Gross output	732,823	733,323	607,593
Returned	325,393	303,355	267,807
Net output	407,430	429,968	339,786
Total outstanding	3,557,750	2,955,514	2,292,602

NEBRASKA TELEPHONE COMPANY.—The Nebraska (Bell) Telephone Company has addressed a circular letter to its subscribers offering $600,000 of additional stock at a par value of $100 per share, the issue having been authorized by the stockholders for the purpose of making extensive improvement in its system and plant. Space in the letter and an accompanying pamphlet is devoted to explaining the company's views of the independent competition.

Commercial Intelligence.

THE WEEK IN TRADE.—Irregular conditions still prevail, but in spite of this there is a tendency to view the general outlook for fall and winter trade with favor. Heavy rains and alleged killing frosts Northwest and in portions of the West, with drought, followed by unseasonably cool weather, and destructive wind and rain storms along the Atlantic coast, have tended to retard expansion in fall trade in widely separated sections of the country. The Northwest returns the poorest reports as to current distributive trade, while the Southwest and Pacific coast and some sections of the South give excellent reports of business already booked or in prospect. Northern Texas will make a larger cotton crop than last year, but the southern part of the State will return less. A feature of the week in New England has been the resumption of a large number of cotton mills, notably at Fall River. Trade in lumber at the East shows little if any improvement, though the resumption of building helps trade somewhat at New York. The iron and steel markets are reported weaker. Buyers of finished materials are said to be holding off at Chicago and at New York, the feeling being that heavy reductions in prices of pig iron since the first of the year should be reflected in lower prices for the finished products. A good volume of business is reported booked for the balance of the year. A better tone in iron is reported from Pittsburg, and orders for finished products are coming in there more freely. In copper the market was dull and inactive, prices being somewhat easier than for some time. The Exchange quotations have not been changed, but in the open market Lake can be obtained at 13½c.; electrolytic at 13.37½c., and casting stock at 13c. A large volume of general business throughout the country is indicated by the railway earnings, which for August showed gross receipts of fully 9 per cent. over those of the corresponding month of last year, and of nearly 10 per cent. over the first week of September. The car shortage is beginning to be felt, especially in the Pittsburg district, where sufficient labor cannot be secured for handling freight. There was a slight increase in the number of business failures during the week ending September 17, the aggregate being 170, against 165 the week previous, and 182 in the corresponding week of last year.

THE SHEFFIELD COMPANY, which is to construct a plant at Sheffield, Ala., for lighting the towns of Florence, Sheffield and Tuscumbia and operating an electric railway, both freight and passenger, to be built by the company between those places, has just placed contracts through its New York office for cars, etc. The American Car & Foundry Company, Jackson & Sharp, Wilmington, Del., branch, has taken an order for eight cars—5 open, 15 bench type and 3 closed, 44 ft. 2 in. The trucks will be Peckham. The motors—4 No. 68—of each car will be of Westinghouse build. The power house, whose initial capacity will be about 850 hp, will be equipped with Wickes boilers, Brown Corliss engines and Westinghouse generators. A 325-kw, three-phase, alternating-current machine will take care of the railway work, while a 250-kw generator will furnish the lighting power.

GOULD STORAGE BATTERY CONTRACTS.—Among the recent contracts secured by the Gould Storage Battery Company are the following: Lexington Street Railway, Lexington, Ky., 256 cells S-613 elements in S-17 tanks, with a capacity of 480 and 640 amperes respectively. An automatic regulating booster of the Gould type will be installed with this battery. Easton Power Company, Easton, Pa., 255 cells of Type S-617 in S-25 tanks, with a capacity of 640 and 960 amperes respectively. Also switchboard and regulating booster of the Gould type. This plant is the second installation made for this company, after extended use of the Gould battery and booster. Northampton Power Company, Easton, Pa., floating battery with a maximum discharge of 360 amperes and 600 volts.

BIDS WANTED.—The Kokomo Railway & Light Co., of Kokomo, Ind., will receive bids up to 2 o'clock in the afternoon of October 14, 1903, at the office of the Kokomo Railway & Light Company and the Indiana Interurban Construction Company, in Kokomo, Ind., for the complete construction of power house, sub-station and installation of all machinery and all equipment therein. Detail plans and specifications covering this work will be on file on and after October 1, 1903, at the office of the companies in Kokomo. Bids will be received for the whole work complete or on various sub-divisions of the same.

MORE AMERICAN EQUIPMENT FOR CAUVERY FALLS PLANT.—The General Electric Company has secured an important contract for generators, etc., to be installed in an extension of the Cauvery Falls hydraulic plant, India. As already mentioned in these columns, the General Electric people secured the contract for the initial equipment. The additional turbines will be of Pelton type built by the Swiss engineering firm of Escher, Wyss & Co., of Zurich. A Scotch firm, Mechan & Sons, of Glasgow, has been awarded the contract for the structural steel.

SYSTEM FOR MOSCOW.—An extensive network of electric lines is to be constructed and operated by the municipality of Moscow, Russia. New lines will be built and then the existing horse roads will be electrically converted. Before the system is completed, which will take about three years, fully 175 miles of lines will be electrically operated. Vladimir F. Gnesin, a well-known Russian electrical expert, Morris Building, New York, can give further particulars to interested parties.

GENERAL ELECTRIC EQUIPMENT FOR AUSTRALIAN PRINTING WORKS.—The General Electric Company has secured a contract for several motors to be installed in the new printing works of J. Sands & Co., Sydney, New South Wales. The contract calls for 61 motors, varying in capacity from ⅛ hp to 1 hp each.

FOR MEXICAN CENTRAL SHOPS.—The new shops of the Mexican Central Railroad, now being built at Aguascalientes are to be equipped with De Laval turbines, two 60-ton electric cranes and some large machine tools built by the Niles-Bement-Pond Company.

INSULATING MATERIAL, ETC., FOR SOUTH AMERICA.—The Standard Paint Company, 100 William Street, New York, reports a substantial foreign demand for insulating material, etc., especially from the Argentine Republic and Chili.

UNION SWITCH & SIGNAL INSTALLATIONS.—Two recent and important contracts by the Union Switch & Signal Company are those for the Interborough Rapid Transit Company (Subway), of New York, and the North Shore Railway, of California. The Westinghouse electro-pneumatic system is to be installed on the first-named, but a new feature is to be introduced, that of using alternating current. It is obvious that the use of track circuits on third-rail roads, where the rails are used for the return circuit, and at the same time for the signaling circuit, introduces what may be serious complications. In order to avoid these difficulties the signals will be controlled by alternating current, through relays that are sensitive to alternating current only, and which will not be affected by the direct current used for train service in the subway. On the North Shore Railway, which runs about thirty miles north from Sausalito, Cal., across the bay from San Francisco, the electric semaphore system of automatic block signals is to be used with a track circuit. This being a high-tension, third-rail electric road, alternating current will be used for the signal system.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed contracts for the installation of batteries of the Chloride accumulator for the Indianapolis & Northern Railway, at Sulphur Springs, Ind., making seven batteries operated by this company at Broad Ripple, Ind.; an increase in the two batteries recently installed for the Los Angeles Railway, Los Angeles, Cal., and an installation for the Northwestern Elevated Railway, of Chicago, Ill. Four new batteries have been contracted for by the Chicago Edison Company, making thirteen batteries operated by this company; an installation for the Paterson Edison Company, Paterson, N. J.; the second battery for the Los Angeles Edison Company, Los Angeles, Cal., and an additional battery for the New York Edison Company, which makes twenty-two batteries operated by this company. Isolated lighting and power plants are being installed for the Murphy Building and for William P. Stevenson, at Detroit, Mich.; Alexander Winton, Cleveland, Ohio; F. T. F. Lovejoy, Pittsburg, Pa.; the House of the Good Shepherd, Roxbury, Mass., and for the Irving Building, Louisville, Kv.

MANILA TRACTION SYSTEM.—Construction work has begun on the Manila electric traction system, in which project J. G. White & Co., 29 Broadway, New York; the Westinghouse interests, Ex-President Buhl, of the Sharon Steel Company; Peter L. Kimberley, of Sharon, Pa., and Charles M. Swift, of Detroit, Mich., are principally interested. J. G. White & Co. will execute the construction work. Seventy-pound rails will be laid, 4,000 tons of which have already been ordered from Wonham & Magor, on behalf of the London iron and steel firm of Suter, Hartmann & Co. The power house equipment will have an initial capacity of 3,000 hp. Westinghouse turbo-generators will be installed. The system, which will be about 40 miles long, is expected to be in active operation inside of 18 months. It will cost between $2,500,000 and $3,000,000.

BALL ENGINE ORDERS.—The Ball Engine Company, Erie, Pa., which is now installing three 400-hp vertical cross-compound, directed-connected engines in the Oliver Building, Pittsburg, Pa., has just received an order for an additional unit—a 700-hp vertical cross-compound Corliss direct-connected engine. This will make one of the largest isolated plants in Pittsburg. The Haskell & Barker Car Company, of Michigan City, Ind., has purchased a 200-hp direct-connected unit from the Ball Engine Company, Erie, Pa. The Ball Engine Company has also sold a 60-hp direct-connected unit to the National Ammonia Company, St. Louis, Mo.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, of Chicago, has designed a new generator call, self-restoring, drop switchboard, embodying a number of important new features. The board will be ready for the market in about 30 days. It is said that the company has a number of orders on file for this type of equipment. Owing to the rapid increase of its business in the Southwest, it has been found necessary to establish a branch sales office at Mexico, Mo. Mr. G. F. Graham, who is well known to the independent interests of that section, has been appointed manager of this division.

PLANT FOR ROSLYN, L. I.—The Nassau Light & Power Company has been giving out contracts for its plant at Roslyn, L. I. The contract for the buildings was awarded to the American Bridge Company. The Alphons Custodis Chimney Construction Company, of 95 Nassau Street, received an order for a 200 x 10-ft. stack. Contracts for the first battery of 1,000-hp water-tube boilers were awarded to Thayer & Co., Limited, of 39-41 Cortlandt Street. The General Electric Company received orders for two 1,500-kw Curtis turbo-generators. Mr. C. O. Mailloux is consulting and contracting engineer for the company.

WESTERN ELECTRIC COMPANY is to have large new buildings in Philadelphia to cost about $100,000, at the southwest corner of Eleventh and York Streets, where its present factory plant in that city will be concentrated. This is trivial, however, compared with the plans for Chicago, involving from $5,000,000 to $7,000,000, in the construction of a plant at Hawthorne, south of Twenty-second Street, and east of Forty-eighth Avenue. Nine buildings are already rising, the contracts for which aggregate $1,207,247. It is expected to have the first part of the work done by February next year.

EQUIPMENT FOR MEXICAN MINES.—The Mexican-American Mining Company, of Sierra Juarez, State of Oaxaca, Mexico, is to construct a hydraulic plant on the Socorro River at a point in the vicinity of Sierra Juarez, for the purpose of developing power to operate its mines. Several water power rights have been recently granted by the Mexican authorities to mining companies, whose properties are near the Socorro and Natividad Rivers, and contracts are pending for the equipment of other plants. The initial capacity of the Mexican-American company's plant will be 200 hp.

LIGHTING EQUIPMENT FOR SOUTH AFRICA.—The Mutual Life Insurance Company, of New York, is to erect a large office building in Johannesburg, South Africa, which will be fitted with American electric lighting equipment. The General Electric Company will furnish the generators, two of 75-kw capacity each, while the contract for the engines has been taken by Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York. There will be two direct-connected engines of 120-hp capacity each, of Harrisburg manufacture.

INDIANA POWER PLANT.—Power enterprises are cropping up quite numerously in the Hoosier State. The Indiana Hydraulic Power Company, of Hindostan, Ind., has been incorporated with $150,000 capital, to construct and operate a water plant at the Hindostan Falls, and to construct a dam on White River. The plant will generate hydraulic and electrical power for manufacturing purposes. The directors are Jerome Herff and Joseph Bergman, Peru, Ind., and Wm. A. Cullop, Vincennes, Ind.

PERUVIAN LIGHTING PLANT.—The Compania Santa Rosa, Limitada, of Lima, which furnishes power for lighting, has just contracted for additional equipment. The existing capacity, which is operated by water power, is 2,000 hp. It is to be increased to 3,000 hp. The Pelton Water Wheel Company has secured a contract for a 1,000-hp water wheel. The generator, a 450-kw machine, will be of General Electric build. The original plant has Pelton wheels and General Electric generators.

BIDS FOR MUNICIPAL PLANT AT CIENFUEGOS.—On September 28 Senors F. Ga Vieta, the mayor, and Rodriguez Pedro Morales, city clerk, will open bids simultaneously at Cienfuegos, Cuba, and in the office of the secretary of state at Havana, for the municipal electrical lighting plant of Cienfuegos. Bids will be received till noon of the day of opening. The city will pay for the plant in yearly installments of $4,000 gold.

J. G. WHITE & CO. SECURE BRITISH CONTRACT.—J. G. White & Co., Limited, of London, has been awarded an important contract for the construction of another British municipal electric traction system, the corporation of Northampton, one of the leading cities in the English Midland district, having allotted them work which will represent an expenditure of more than $200,000.

MEXICAN HYDRAULIC POWER PROJECT.—John R. McDonough, of Mexico City, is after a concession which will permit of his constructing a hydraulic plant at the junction of the Del Valle and La Asuncion Rivers. Application has been made to the Mexican authorities with a view to utilizing 8,000 liters per second.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester and Chicago, recently closed a contract with the Benson Telephone Company, Benson, Minn., and the Red River Valley Telephone Company, of North Dakota, for one of its 400-line generator call visual signal switchboards.

ELECTRIC TRACTING FOR TORREON, MEXICO.—An electric traction system is about to be constructed in the city of Torreon, Mexico. A company has just been organized for the purpose of building and operating the road. D. Daniel Rios Zartuche is primarily interested in the enterprise.

TELEPHONY AND LIGHTING.—The Johnstown Light, Heat & Power Company, of Johnstown, Pa., is going into the telephone business and will put in a first-class exchange, to be located at the central station. Mr. J. W. Reeves is general manager and Mr. August Weis is superintendent.

ALASKA CABLE SHIPMENT.—The Safety Insulated Wire & Cable Company, 114 Liberty Street, New York, has just completed the shipment of 1,300 miles of deep sea submarine single-conductor cable for the Alaska system.

General News.

THE TELEPHONE.

LOS ANGELES, CAL.—Articles of incorporation have been filed with the County Clerk by the Monrovia Telephone & Telegraph Company, with a capital stock of $50,000, of which amount $5,000 has been subscribed. Monrovia will be the company's principal place of business. The incorporators and directors are D. E. Juvinall, M. Juvinall, C. O. Monroe and George McLaughlin.

WHITEWATER, KAN.—The Whitewater Telephone Company has been incorporated with a capital of $2,500. This company will establish a local exchange in Whitewater which will be in connection with the long distance lines of the Wichita Telephone Company.

JACKSON, MICH.—The Munith & Grass Lake Telephone Company has filed articles of association in the sum of $2,500. The company is organized for the purpose of operating and maintaining a general telephone business in this county. The stockholders are M. A. Taylor, A. A. Welch, H. H. Murray, F. J. Kilpatrick, J. C. Welch, D. J. Soper and F. Welliman, of Grass Lake, and Fred Schrak, B. Suylandt, C. Harr, D. Vanderlyn, C. M. McIntee, F. Harr, G. Heydloff, G. Walz, J. G. Harr, N. Lanlis, Agnes Randolph, W. Dixon. T. Ready, J. Hoyt and P. Cavender, all of Munith.

ST. LOUIS, MO.—The organization of the St. Louis County Telephone Company has been completed at Clayton and the incorporation papers have been sent to the Secretary of State. The company has a capitalization of $1,000, but this amount will be increased, it is said, as soon as the work of installing the plant is begun. The first board of directors consists of H. J. Weber, J. B. C. Lucas, J. Kessler, Ernest Marshall, G. W. Von Schroeder, F. A. Heidorn, Albert Jacobsmeyer, Alex Kessler, H. W. Karrenbrock, Judge Edward Rannells, Edward Miller, D. Clinton Taylor and J. D. Houseman. A meeting will be held in a few days for the purpose of adopting by-laws, etc.

LACONIA, N. H.—A switchboard capacity of 300 drops, with 25 miles of toll line, is operated by the Citizen's Telephone Company. The rates are $15 and $18 per annum. There are at present 1,100 subscribers, of which 350 were added since January 1. The Citizen's Company is constantly extending its work and reports the outlook as remarkably good.

NEW LISBON, N. J.—The Farmer's Telephone Company operates Kellogg apparatus; has a switchboard with 50 drops and 75 subscribers. The subscription rate is $20 a year. This company is just completing a 20-mile line, with two exchanges and three toll stations from New Egypt to Allentown. Its prospects are good.

PLATTSBURG, N. Y.—The Clinton Telephone Company of Plattsburg has been incorporated to construct lines in Northern New York; capital $50,000. Directors: John M. Wever, R. S. Rumsey and Isaac Merkel, Plattsburg.

OXFORD, N. Y.—Messrs. Mead & Derrick, of the Oxford Exchange, inform us that business has doubled within a few months. There are 100 miles of toll line, and subscribers pay $18 for business and $12 for residence service.

MILFORD, N. Y.—A gradual increase is the report from the Milford Telephone Company, which operates a 50-drop North switchboard, has 120 miles of toll lines and 50 subscribers. The subscription rate is $15 per annum. Mr. Cuyler E. Carr sends us this information.

PERRY, N. Y.—With 180 subscribers on Sept. 1, 100 of which have been added since February of this year, the Perry Telephone Company reports still further probable increase during 1904, when 50 new telephones are to be installed. A 320-drop switchboard is operated. Mr. C. W. Smith is manager.

EARLVILLE, N. Y.—The Earlville Telephone Company of Earlville, Madison County, has been incorporated to operate in Madison and adjoining counties; capital $40,000. Directors: Parker Newton, Gertrude C. Newton, Ernest C. Newton, Morris Newton, Guy H. Clark, Clayton I. Burch and Avery M. Hoadley, all of Earlville.

MALONE, N. Y.—The Franklin County Telephone Company reports good progress and states that it is giving satisfaction. It uses Stromberg-Carlson apparatus, the switchboard capacity being 200 drops. There are 340 subscribers, who pay $15 annually for their service. At present there are 15 miles of toll lines and 20 more are projected. In the past eight months the business has increased about one-third.

NEWARK, N. Y.—The telephone plant here was built in 1898, and opened in February of 1899 with 65 subscribers. Without solicitation this number has steadily increased. There are 210 subscribers. Connecticut Telephone & Electric Company's apparatus is used, the switchboard being of 200 drops. Business charges are $20 and residences $15 and $12 per annum. There are a number of applicants for service, whose demands cannot be supplied until new cable is installed.

NEW YORK, N. Y.—The New York & Long Island Telephone Company operates in Nassau and Suffolk counties, N. Y. It has six central offices, in four of which there are switchboards of 100 drops each, one with 150 drops and one with 300 drops. Kellogg and American apparatus is used. There are 600 subscribers. The rates are from $20 to $30 per annum, toll five cents for five miles. The company estimates the recent growth at 20 per cent., and contemplates an increase of 20 per cent. in the territory in the coming year. The outlook is favorable. Extensions under way will add 100 per cent. more toll line, five more exchanges and 700 more subscribers. Mr. D. James Cronk, the engineer and manager of this company, informs us that the best of construction material is being used, poles, cables, No. 12 B. & S. copper trunk, and that they are doing some U. S. Government work, and combining as large a territory as possible in each office.

SALISBURY, N. C.—Mr. W. F. Snider is the owner of the Salisbury Telephone Company, which uses Williams-Abbott apparatus. The switchboard has a capacity of 400 drops; there are about 100 miles of toll line. Mr. E. C. Heins is manager of this exchange as well as that of the Spencer Telephone Company, Spencer, N. C. The Mt. Airy Telephone Company is operated in connection with these two. The rates are from $18 to $24 per annum. The system is growing very rapidly. It is expected to add from 75 to 100 telephones.

MORNING SUN, OHIO.—The Morning Sun Telephone Company has been incorporated by R. H. Douglas, W. M. Cook, J. R. McCrary, S. M. Paxton and S. C. Weed. Capital, $10,000.

DOYLESTOWN, OHIO.—A North 100-drop switchboard is operated by the Doylestown Telephone Company, which has 100 subscribers and 25 miles of toll line. The company reports a 25 per cent. increase within a year, and some extensions are to be made. The rate is $12 per annum for each telephone.

QUAKER CITY, OHIO.—The entire system of the Quaker City Telephone Company is being rebuilt, and its 80 subscribers are well pleased with the service. There has been an increase of over 20 per cent. in the last year. This company's rate is $1 a month; it uses American Electric apparatus.

SHELBY, OHIO.—The Shelby Local Telephone Company operates a 500-drop North switchboard, giving service at $1 and $2 a month. Of the 700 subscribers 125 have been added since March, and the manager, Mr. F. B. Chapman, tells us that the outlook is good for 1,000 subscribers at end of 1904.

ASHLEY, OHIO.—The New Ashley Telephone Company uses a Stromberg-Carlson 100-drop switchboard, which gives service to 135 subscribers. The rates are $12 and $18 a year. Twenty-five telephones have recently been added and "prospects are good," says Mr. G. M. Dennis, secretary and manager, "if we could get men to do work."

LONDON, OHIO.—The London Home Telephone Company has just commenced to reconstruct its line, putting in about 5,000 feet of cable. It has at present more subscribers than it can accommodate, there being 1,000 of them. An American Electric 500-drop switchboard is operated; the service costs $2 per month for business and $1 for residences. Mr. W. J. Meech is secretary and general manager.

MT. STERLING, OHIO.—A total of about 275 subscribers is accredited to the Mt. Sterling Telephone Company by its secretary and manager, Mr. H. Clay Johnson, who tells us that about fifty telephones were added last year and that the system is in good condition. An American switchboard of 300 drops is used; there are about 80 miles of toll line, and the subscription rates are from $1 and $2 per month.

BRIDGEPORT, OHIO.—The Belmont Telephone Company operates five exchanges, Barnesville, 350 subscribers; Bridgeport, 210; Martin's Ferry, 240; St. Clairsville, 125; Belmont, 25. One hundred and fifty miles of toll line are operated. Mr. A. H. Dondua, the general manager, tells us that the prospective gain is four to five per cent. per month. One exchange and some new toll lines are projected. The company uses the central energy system, and general satisfaction is felt by subscribers.

HAMILTON, OHIO.—The Hamilton Home Telephone Company which began business on Jan. 15, with about 600 subscribers, has passed the 1,000 mark and now has 1,011 telephones in this city. In addition it has one hundred subscribers on its Bethany exchange and a number of other city contracts are about to be closed. The work of building a metallic circuit line to Dayton, Ohio, will soon be commenced. This will give the company direct connection from here with Columbus, Cleveland, Toledo and other importnat points in Ohio, and also with Pittsburg.

CLEVELAND, OHIO.—Acting General Manager French, of the Cuyahoga Telephone Company, informs us that by the first of the year his company expects to have its present equipment replaced by the latest type of common battery and lamp signal equipment, thus doing away with the divided multiple exchange board. He adds: "With its four divisions A. C. M. and R. our new equipment is the best money can buy and we look for an era of unparalleled prosperity for the company." The Cuyahoga Company operates a very large system, having 8,229 subscribers. North and Kellogg apparatus is used. The recent growth has been satisfactory, but no special effort has been made to secure new subscribers owing to the contemplated change in the system noted above. When the new system is in working order a general canvass will be made to increase the number of subscribers.

LANSFORD, PA.—The Carbon Telephone Company has forty subscribers, the subscription rate being $1 a month. This company has secured franchises in East Mauch Chunk and Mauch Chunk and contemplates building a ten-mile line.

KITTANNING, PA.—The common metallic system is being installed by the Kittanning Telephone Company, which uses American Electric and Stromberg-Carlson apparatus. The subscription rate to the 425 subscribers is $15 to $18 per annum. Mr. K. B. Schotte, secretary and treasurer, says the outlook could not be much better.

LEWISTOWN, PA.—The United Telephone & Telegraph Company of Philadelphia, which operates the system in this city, is the successor of the old Spring Telephone Co. which was merged with the Juniata & Susquehanna Telephone Co. and the latter afterwards with the United Co. The company's switchboard here has a capacity of 450 drops. It has 750 subscribers, the apparatus used being that of the Western Telephone Construction Company, Kellogg and American. The company operates 65 miles of toll line, and among the improvements planned is the establishing of an exchange at Duncannon and the extension of its country lines about 20 miles. Mr. D. L. Temple, division manager, notes that he has recently installed a private branch exchange which has a battery pressure of 50 volts and has but one relay for each cord, at the same time giving the full supervisory signals. In addition to this the company is giving connections from the central energy telephones to its long distance lines to Philadelphia and other points without the use of repeating coils as is the present custom and it finds that it is getting much superior service to that given when repeating coils are used. The rates for Lewistown are $18 to $30 per annum.

DEADWOOD, S. D.—The Nebraska Telephone Company is seeking a new franchise and promises to spend $30,000 in improvements.

ELECTRIC LIGHT AND POWER.

LOS ANGELES, CAL.—The announcement is made that H. E. Huntington is looking to the San Joaquin River as a source of power for his mammoth electrical projects in Southern and Central California. The plans are large, involving the expenditures of millions of dollars, the long-distance transmission to take the water out of the main river twenty miles north of Shaver and by a series of tunnels and pipe lines carry it through the mountains to the South Fork. The largest tunnel will be one mile in length. From this point the waters of the South Fork and those of Big Creek will be carried on to a place affording natural reservoir facilities, giving a fall of over 2,000 feet. Then the water will be carried along by conduits and tunnels a distance of four and a half miles, making another drop of 1,700 feet. With the normal low water of river and conserved flood waters, there will be a flow of nearly 1,000 miner's inches.

ELBERTON, GA.—Capt. D. B. Cade, of Elbert County, is the chief promoter of a company proposing to develop Anthony Shoals near Elberton. The dam will cost $107,000 and the canal $60,000. It is estimated that 22,000 horse power is available.

LEWISTON, IDA.—The Idaho Water Power Company has filed articles of incorporation at Lewiston, with a capitalization of $1,000,000. The company will build an electric railway system from Orofino to Pierce City, a distance of 30 miles, and one from Orofino to Nezperce. The company will also operate telephone and telegraph lines. The officers and directors are William L. Cook, president; Elmer Waldrip, secretary; Frank A. Farrish, William T. Farrish and Simon P. Fitzgerald. The power plant of this company will be installed on Orofino Creek, a purchase at that point having been made of the holdings of the Cascade Lumber and Power Company. When the surveys are completed, the company will solicit bids for the construction of a flume and the installation of a power plant. The flume will be 1,000 feet in length.

DIXON, ILL.—The Lee County Lighting Company has been incorporated by Edward B. Darling, E. H. Cassell and F. E. Bailey. Capital $100,000.

ROSEDALE, IND.—The citizens of this place are considering a proposition to establish a new lighting plant here.

WEST LEBANON, IND.—It is reported that a water works and electric light plant is to be installed here by Wm. H. Goodwine.

WESTSHOALS, IND.—The Indiana Hydraulic Power Company, of Hindostan, Martin County, has been incorporated, with a capital of $150,000, to construct and operate a water plant at the Hindostan Falls. The water power will be used to generate hydraulic and electric power for manufacturing and other purposes. Directors: Jos. Andrea and Jerome Herff, both of Peru, and Wm. A. Cullop, of Vincennes.

ACKLEY, IA.—The Ackley Electric Light & Power Company's plant has been disposed of to Smith Brothers, of Central City, Colo.

CUMBERLAND FALLS, KY.—H. C. Brunson, president of the Cumberland Falls Power Company, writes that complete plans for contemplated improvements will not be completed until about Dec. 1, and the company will be ready to open bids about June 1, 1904, for said improvements, the probable cost of which will be $1,800,000. C. P. Folsom, Dayton, Ohio, is engineer in charge.

PORTLAND, ME.—The Belfast Gas & Electric Company, capital $60,000, has been incorporated by Arthur B. Sederquist, Boston, Mass., H. P. Sweerser, Portland, and others.

RIVER ROUGE, MICH.—McCleary & Colquith, of Detroit, have secured the contract for constructing an electric light plant at River Rouge for $19,570.

DETROIT, MICH.—M. R. Bacon, of the Michigan Alkali Company, and Frank Nellis, of Wyandotte, Mich., are interested in a company formed for the purpose of supplying power to the manufacturing industries along the line of the Detroit & Toledo Short Line now in course of construction. The plant of the new company will be at Rockwood, and will furnish the Detroit & Toledo Short Line the necessary power to operate the road between Monroe and Detroit. The flow of the Huron River will be utilized for the generation of the power.

ST. CHARLES, MINN.—The St. Charles Light & Power Company has been organized, with M. J. McGrath, of Winona, as president, and Charles F. Knapp, of St. Charles, as secretary and treasurer. Capital, $12,000.

CHASKA, MINN.—J. G. Robertson, of St. Paul, Minn., secured the contract for an Ideal engine for the electric light plant at $2,228, and the Triumph Electric Company, of Cincinnati, Ohio, for a generator at $1,597.

LINCOLN, NEB.—The Fullerton Electric Light & Power Company has filed articles of incorporation with the Secretary of State, its capital stock being $20,000. The incorporators are A. Ellsworth, I. I. Bennett, W. P. Hatten and S. F. Rolph.

NEWARK, N. J.—The East Coast Electric Light, Power & Ice Company, of Newark, has been incorporated with a capital of $100,000 by Chas. Dutton, Jos. Gerrardt and Jas. R. Mapletoft.

GOUVERNEUR, N. Y.—The Village Trustees have granted J. Henry Abbott a franchise for an electric light plant.

EDENTON, N. C.—The Town Council will receive bids at once for the construction of water works and an electric light plant.

LAURINBURG, N. C.—W. Drummond Marrow, of Charlotte, is the engineer and contractor for the proposed electric light plant at Laurinburg; the probable cost of which will be $10,000.

SHELBY, N. C.—The Westinghouse Company is preparing plans for equipping a big water power plant for the Lily Mill & Power Company to furnish electric power to cotton mills at Shelby. It is said that the electric power will be much cheaper than the steam power now in use.

CLEVELAND, OHIO.—The Cleveland Engineering Company is preparing plans for a central heat, light and power station to be erected in the business section of Cleveland, by W. F. Black, Electric Building, this city. The plant is to be located in the business district bounded by Euclid Avenue, Sheriff Street, Ontario Street and Prospect Street, to furnish steam heat and electric light and power in this block. The plant will cost about $150,000.

CUYAHOGA FALLS, OHIO.—It is stated by Mayor Young that a number of Eastern capitalists have become interested in a project for a water power plant near Cuyahoga Falls. There is a considerable fall in the river and a large amount of power could be obtained at all seasons of the year. It is only eight miles from Akron and twenty miles from Cleveland, while manufacturing plants in Cuyahoga Falls are expected to take considerable power. It is estimated that the plant would cost about $1,000,000.

OKLAHOMA CITY, OKLA. TER.—It is reported that the Oklahoma Gas & Electric Company will expend about $75,000 in enlarging and improving its plant.

WILLIAMSPORT, PA.—The proposition to issue bonds for a municipal plant is being considered.

CORRY, PA.—The Corry City Electric Light Company, of Corry, has been incorporated, with a capital of $21,000.

BERNVILLE, PA.—The Deem Electric Construction Company, of Reading, has received the contract for the installation of an electric light plant in this place.

HARRISBURG, PA.—The Harrisburg Light, Heat & Power Company has reduced its rates for incandescent lighting from 15c. per kw-hour to 10c. per kw-hour. Graded discounts will be allowed.

SUNBURY, PA.—The West Branch Valley Electric Light Company has been formed under New Jersey laws, with a capital stock of $3,000,000, to use the power of the Susquehanna River at this place for the operation of electric light plants. The new company has procured options on twenty plants.

WATSONTOWN, PA.—Mr. T. H. Kisner, secretary of the electric light department of this borough, states that this town offers good opportunity for electrical enterprise. There is a dam in the river four miles from the town that could be utilized for the development of electrical energy. Mr. Watson states that a line of general supplies is needed for the electric light service.

SPARTANBURG, S. C.—Ladshaw & Ladshaw, of Spartanburg, have secured a contract for developing 40,000 horse power for electrical transmission on Little Tennessee River in Swain and Graham counties, Tenn. A preliminary survey is being made.

GREENVILLE, S. C.—As the result of the consolidation of a number of southern water power companies there has been formed in South Carolina the Southern Water Power Company with $2,000,000 capital. The center of operations will be at Greenville and the company will expend more money than any similar concern has ever spent in the state.

YOAKUM, TEX.—The electric light and power plant of the Yoakum Improvement Company at this place is to be enlarged.

DALLAS, TEX.—The electric light and power plant here, which is owned by Stone & Webster, of Boston, Mass., is to be enlarged.

EUREKA, UTAH.—The Eureka Electric Company has been organized under the laws of Colorado to furnish light and power in Eureka. The capital stock is $36,000. W. B. Searle is president, and A. L. Woodhouse, secretary.

WALLA WALLA, WASH.—The Washington & Oregon Power Company has been incorporated, with a capital of $300,000, to construct the new power plant of the Northwestern Gas & Electric Company on south fork of Walla Walla River. Isaac W. Anderson and Geo. L. Munn are among the incorporators. It is reported that the Walla Walla Gas & Electric Company has transferred its plant to the Northwestern Gas & Electric Company.

WOODSTOCK, WIS.—It is stated that $8,000 bonds are to be issued to enlarge the water and light plant.

KENOSHA, WIS.—The Kenosha Gas & Electric Company has received plans for a new power house to be erected here. Work has already begun on the improvements.

MATAMOROS, MEX.—John W. Maxcy, of Houston, Tex., and associates contemplate establishing an electric light plant here. Application will be made to the municipal and state authorities for concessions for the proposed public improvement.

ORIZABA, MEX.—It is stated that the electric light and power plant here which is already furnishing light and power for a number of towns and manufacturing concerns of this section is to be enlarged and its electric transmission lines extended. Licenciado Joaquin Villada, of the City of Mexico, can probably give information in regard to the matter.

CULIACAN, MEX.—Henry T. Lavellert, of San Francisco, has been investigating the water power available in the rivers of this state with the view of establishing a large electric power plant to provide electric power and lights for this town as well as for a number of mines and industrial concerns of the state. He will make appliaction to the Mexican government for a concession for the proposed enterprise. He states that he represents a syndicate of American capitalists who have several hundred thousand dollars to invest in the enterprise if it is found to be feasible.

FORT WILLIAM, ONT.—Papers were signed on September 12 by which the Kakabeka Land & Electric Company agrees to sell power to this town in any quantity at $18 per horse power per annum. The company will begin its work in one hundred days, and it agrees to have developed and to deliver to the town of Fort William 5,000 horse power within two years. The city retains its franchise of light and water. Kakaheka Falls are located a few miles from this place and have a capacity of 30,000 horse power.

THE ELECTRIC RAILWAY.

FORT SMITH, ARK.—The Sebastian County Electric Railway Company has been incorporated, with a capital stock of $1,000,000, to build an electric railway to connect Fort Smith, Jenny Lind, Greenwood, Bonanza, Mansfield and Hartford and to furnish these cities with electric light and power. The officers of the company are S. A. Williams, president; Wharton Carnall, secretary and treasurer; H. G. Bollinger, vice-president.

LOS ANGELES, CAL.—Standardizing the lines of the Pacific Electric Railway Company in Pasadena has been completed and the construction camps are now at work on the division into Rubio canon.

HAZLEHURST, GA.—The City Council has granted a right of way and other privileges to Russell & Seeckle, promoters of the proposed electric railway from this city into the western portion of this county.

GAINESVILLE, GA.—The Atlanta, Buford & Gainesville Railway Company has applied for a charter and proposes to erect an electric plant on the Chattahoochee River to furnish power for operating a street railway from Gainesville to Atlanta, and for furnishing power for Buford and other points along the line. Options are being taken on large tracts of land near the river. The petitioners for the charter are H. D. Jaquish and C. C. Sanders, of Gainesville; M. S. Garner, G. W. Thompson, J. O. H. Brown, of Buford; E. J. Michael, of Idaho; J. W. Peterson, W. W. Gorman and G. W. Winslow, of Chicago, and D. B. Stancliff, of Atlanta. The capital stock of the company is to be $100,000.

KEWANEE, ILL.—The City Council has granted a fifty-year franchise to the Kewanee, Cambridge & Geneseo Electric Railroad Company.

JERSEYVILLE, ILL.—The Union Traction Company, of Jerseyville, has been incorporated, with a capital stock of $2,500. The object of the company is to build an electric railway and furnish light and power. The incorporators are A. O. Auten, June M. Rhoades and Joseph W. Becker.

CHICAGO, ILL.—Marshall Sampson, one of the receivers of the Chicago Union Traction Company, who has just returned from New York, is quoted as authority for the statement that steps are to be taken at once to equip with electricity all the lines of the company now operated by cable..

MUSKOGEE, I. T.—C. N. Haskell, for the Muskogee Traction Company, has given a bond of $10,000 to commence work on the street railway in Muskogee within thirty days. Cars are to be running within fifteen months.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company has decided to authorize a bond issue of $1,000,000, the proceeds of which are to be used in extending and equipping the company's lines in New Albany and Jeffersonville and its interurban lines, and in acquiring and purchasing other lines. The company has already projected an interurban line from New Albany to Corydon, Wyandotte Cave and Leavenworth, and another from New Albany to French Lick and West Baden Springs. Still another interurban line that the company has in contemplation will extend from Jeffersonville to Madison, along the Indiana side of the Ohio River. These lines the company expects ultimately to build. In addition to the new lines the company has in contemplation, it will make vast improvements in the lines it already has in operation between New Albany and Jeffersonville. The company expects to double track a good portion of this line, and the Big Four bridge will have to be equipped when the line is extended to Louisville. Improvements will also be made in the New Albany Street Railway system, a portion of which will be double tracked. There will also be some extensions to the New Albany Street Railway lines.

CADILLAC, MICH.—The Council has before it a proposition to grant a franchise for an electric railway in twelve of the principal streets and around the little lake. The projectors are W. J. Cornwell, of Cadillac; F. O. Gaffney, of Lake City, and James H. Orr, of Warren, Ohio.

DULUTH, MINN.—It is said that the Duluth-Superior Traction Company will spend $40,000 on new machinery to be installed in the power house in Duluth.

KANSAS CITY, MO.—The City Council of Kansas City, Kan., has passed an ordinance granting the Metropolitan Street Railway Company the right of way across the James Street viaduct for the stock yards line, for which the company is to rebuild the Seventh Street Viaduct. The viaduct is across the Union Pacific and Missouri Pacific tracks, a concession which the Metropolitan has been endeavoring to secure for some time.

TRENTON, N. J.—The Trenton Street Railway Company has decided to make an important extension, the building of a second route to Cadwalader Park. This will give electric railway facilities to a desirable portion of the town which is but sparsely settled.

TRENTON, N. J.—A map has been filed with the Secretary of State by the Burlington & Mount Holly Railroad Company, covering the route of a proposed line from Morrisville into Trenton, to connect with the line of the Camden & Trenton Company, the connection to be made at Bridge and Union Streets, and from that point over Union and South Warren Streets to the center of town. No papers were filed with the map, but it is generally understood that the company is the Pennsylvania Railroad, which was formed two years ago to equip with electricity the Pennsylvania's branch lines in Burlington County.

SYRACUSE, N. Y.—It is stated that the Auburn & Syracuse Electric Railroad Company has decided to proceed at once with the work of double tracking its road as far as Mauellers.

ITHACA, N. Y.—The Ithaca-Horseheads Electric Railway Company will soon file letters of incorporation at Albany. The capitalists interested in the road are W. H. McFarland, of Toledo, and M. D. Baly, of the Standard Oil Company, of Cleveland. The company has been able to extend the originally proposed line from Horseheads over Grand Central Avenue to Elmira Heights, and thence over private right of way into Elmira. The road will extend to Enfield Glen, through Newfield, Pony Hollow and Alpine, where the power house is to be built, to Odessa and to Horseheads. It is proposed to lay a double-track system from Ithaca to Newfield. The entire length of the line will be 59 miles. The Chemung River will be crossed at Big Flats by a 350-foot span.

GREENSBORO, N. C.—The Greensboro, N. C., Street Railway Company may extend its lines to one or more neighboring towns. The legislature has granted a charter to the company for extensions to High Point and Winston-Salem.

MARION, OHIO.—The Columbus, Delaware & Marion Railway Company has completed its line into Marion, and cars are now running in regular service between Columbus and Marion.

COLUMBUS, OHIO.—W. H. Luchtenberg, contractor for the Columbus, Marysville & Bellefontaine Railway, states that actual construction work on the line will start within forty days. Practically all the right of way has been secured.

ZANESVILLE, OHIO.—The Southern Ohio Railway, Light & Power Company has been incorporated by M. H. Hissey and others. Temporary capital stock is $10,000. It is proposed to build an electric railway from Zanesville to Roseville, Crooksville, Sayre and New Lexington.

LIMA, OHIO.—The annual meeting of the stockholders of the Western Ohio Railway was held recently, and the following officers were re-elected: A. E. Akins, President; L. J. Wolf and J. R. Nutt, vice-presidents; M. J. Mandelbaum, treasurer; H. C. Lang, secretary, and F. D. Carpenter, general manager.

CINCINNATI, OHIO.—It is announced that the Interurban Railway & Terminal Company is planning to extend its Rapid Railway from Lebanon to Xenia. In connection with the Springfield & Xenia Railway, already in operation, this would form a new through system between Cincinnati and Springfield.

CLEVELAND, OHIO.—Property owners on West Madison Avenue, in Lakewood, have signed a petition which will be presented to the Lakewood Council, requesting them to give a franchise to the Cleveland Electric Railway to run to Rocky River out West Madison Avenue. R. B. Martinetz, who is one of those interested in getting signatures to the petition, stated that the railroad committee had promised, if a twenty-five-year franchise is obtained from the Lakewood Council, to extend the road out that way inside of two years.

PHILADELPHIA, PA.—The Northern Street Railway Company has been incorporated to build five miles of electric railway in Beaver County. William Redwood Wright, of Philadelphia, Pa., is president of the company.

PHILADELPHIA, PA.—The Germantown & Chestnut Hill Belt Line Railway has been incorporated to build an electric railway at Germantown. F. C. Eberhardt, John McConley and W. B. Eltonhead, Germantown, are interested

JOHNSTOWN, PA.—The Johnstown, Woodvale Heights & Conemaugh Street Railway Company has been incorporated to build a four-mile electric railway here. The company is capitalized at $30,000, and the president is Joseph H. Berlin, of Johnstown.

DOYLESTOWN, PA.—Plans are progressing for the extension of the New Jersey & Pennsylvania Traction Company's lines now running from Newtown to Trenton, and from Newtown to Willow Grove. It is thought the road will be in operation within a year.

DARBY, PA.—The Philadelphia, Morton & Swarthmore Street Railway Company is making rapid progress with its extension into Darby. The work of building the bridge over Darby Creek has been commenced, and tracks have been laid across Springfield Avenue in the borough.

CLARKSVILLE, TENN.—The Clarksville Street Railway Company will, it is reported, build an extension to Dunbar's Cave, three miles, and possibly other extensions will be built to New Providence and through South Clarksville.

SALT LAKE CITY, UTAH.—T. P. Steffey, Milando Pratt and F. M. Lyman, Jr., have applied for a franchise to build an electric railway through the county. It is proposed by them to build an electric railway from Springville to Logan via Provo, Salt Lake and Brigham. The promoters have already secured a franchise in Utah County, and will apply for the same rights in Davis and Weber counties at once. They have petitioned the City Council of Salt Lake City for a similar grant through the metropolis, but no action has yet been taken on the matter by that body. It is understood that United States Senator Smoot, State Senator C. E. Loose and others, with the Telluride Power Company, are behind the project.

RICHMOND, VA.—It has been definitely decided to extend the Seven Pines line of the Virginia Passenger & Power Company to Mechanicsville, which is ten miles beyond the present terminus of the line.

JANESVILLE, WIS.—The Janesville Traction Company announces that it will not build the proposed $1,000,000 line from Janesville to Madison, owing to the clause in the franchise which makes its life thirty-five years instead of fifty years.

MADISON, WIS.—The Chicago & Northwestern Lakes Electric Railway Company, which proposes to build an electric railway from Chicago to Kilburn City, has filed articles of incorporation with the Secretary of State. The capital stock is $50,000. The incorporators are Alexander Clark, Charles S. McIlvain, Samuel M. Hamilton, of Chicago; Fred Kull, E. P. Wheeler, of Lake Geneva.

GUELPH, ONT.—On September 28 the ratepayers of Guelph will vote on a by-law to purchase the Guelph Street Railway. The price agreed upon is $78,000, of which $30,000 is to be in cash, $48,000 representing the bonded debt. The road originally cost $100,000.

NEW INDUSTRIAL COMPANIES.

THE THOMPSON ELECTRIC COMPANY, of St. Paul, Minn., has been incorporated with a capital stock of $25,000. The names of the incorporators are Frank B. Thompson, of St. Paul, and William G. Gordon, of Stillwater.

THE ERNEST J. WILLIS COMPANY has been incorporated in New York to manufacture automobile vehicles. The capital stock is $75,000. The incorporators are Ernest J. Willis, Raymond Cole and W. E. Baker, all of New York City.

THE BUNDY ELECTRICAL SUPPLY COMPANY has succeeded to the business of the Bundy Electrical Construction Company, of Binghamton, N. Y. Mr. A. H. Shaffer and L. B. Erwin are at the head of the business, Mr. Erwin being manager.

THE CRAWFORDSVILLE ELECTRIC COMPANY has been organized in Crawfordsville, Ind., to build dynamos, transformers, arc lamps, switchboards and general electrical appliances. The capital stock is $30,000, of which $25,000 has been paid up. The officers are: President, W. F. Hulet; vice-president, H. W. Ornbaun; secretary, Geo. B. Luckett; treasurer, Hal McClamroch; general manager, O. C. Irwin.

PERSONAL.

J. B. MC CALL.

MR. J. B. McCALL.—We are glad to present herewith the portrait of Mr. McCall, who has just been elected president of the Association of Edison Illuminating Companies, and to add a little biographical data. Joseph Benjamin McCall was born in New York City in the year 1869, but his parents shortly afterwards moved to Philadelphia. He began his business career in 1885 in the office of Rufus E. Shapley, attorney-at-law, early attracting the attention of Messrs W. L. Elkins and Martin Maloney, of the Elkins-Dolan-Widener syndicate; the result being that he accepted a position as stenographer in their Pennsylvania Globe Gas Light enterprise for constructing gas works and naphtha street lighting, and soon rose to the position of secretary. In 1895 the Pennsylvania Heat, Light & Power Company was formed by Mr. Elkins and Mr. Maloney with Mr. McCall as secretary and treasurer. In 1898 the Pennsylvania Manufacturing, Light & Power Company was organized with Mr. McCall as president, and he accepted the same position with the Philadelphia Electric Company, the present parent holding security company when it was formed in 1899. The remarkable success achieved by these companies in the electric light field of Philadelphia speaks volumes for the able management of Mr. McCall. His judgment, business intuition and executive ability are of a high order, and his charming and democratic manner insures pleasant relations with all, high or low, with whom he comes in contact. Thus far he has declined to take part in any outside enterprise, devoting his entire time and attention to the building up of a great electric light property.

MR. W. R. CORSON, consulting engineer, has removed his offices in Hartford, Conn., to Room No. 724 in the Connecticut Mutual Life Insurance Building, Main and Pearl Streets.

MR. F. V. L. TURNER has resigned as general manager of the Cuyahoga Telephone Company, Cleveland, Ohio, and O. F. French, assistant chief engineer of the Federal Telephone Company, has been appointed acting manager.

MR. T. H. OREDEN has resigned the managership of the Cape Breton Electric Company, Ltd., which operates the Sydney and Glace Bay Railway and supplies power and lighting current to Sydney, C. B.

MR. H. H. HUNT, manager of the Tampa, Fla., Electric Company, has been called to Stone and Webster's home office in Boston to take charge of their southeastern group of properties as district manager. G. H. Wells has succeeded Mr. Hunt at Tampa.

MR. GRANBERRY JACKSON, of the firm of Jackson & Omberg, consulting engineers, Memphis, Tenn., has recently accepted a professorship in the engineering department of the Vanderbilt University, Nashville, Tenn., where he should now be addressed.

MR. W. J. HAMMER has just recovered from a serious three weeks' illness, brought on by his recent unremitting experiments with radium that have attracted so much attention. Mr. Hammer attributes his indisposition, however, rather to the work than the curious effects of radium.

MR. W. J. SPLATT, of Splatt, Wall & Company, Perth, Western Australia, is in this country for a short visit. Mr. Splatt's firm, which is the leading electrical house in West Australia, has made a specialty of introducing American electrical machinery and appliances in that section of the world.

SCHEIBLE-LEARY—Announcement is made of the marriage in Chicago of Miss Anna M. Leary to Mr. Albert Scheible, who has for so many years past been actively connected with electrical interests in that city. The happy pair have the hearty congratulations and good wishes of a host of friends.

MR. M. R. McADOO, president of the Compania Mexicana de Traccion (Mexican Traction Company), is at present in New York to confer with the American directors of the company regarding contracts, etc., at the offices of W. G. McAdoo, 15 Wall Street. He returns to Mexico City early in October.

MR. PRESTON PLAYER has been appointed superintendent of the Brockton Edison Company, a Massachusetts electric lighting organization under the management of Stone and Webster. Mr. Player is a former resident of Worcester, Mass., a graduate of Harvard and the Massachusetts Institute of Technology, and was for some time with the Walker Company of Cleveland before going to Boston.

DR. I. N. TAYLOR has been appointed to the chair of electrical engineering at the Western University of Pennsylvania. Dr. Taylor was formerly one of the faculty of Syracuse University, and recently passed a year in research work in Germany. A study in electrical discharges attracted much attention from German authorities, and will probably be continued in this country under the auspices of the Carnegie Institution at Washington.

MR. A. C. WALL, of the law firm of Vredenbergh, Wall & Van Winkle, of Jersey City, has been elected president, and Marshall Van Winkle, of the same firm, vice-president of the Hudson and Manhattan Railroad Company, incorporated to build and operate a tunnel from Jersey City to Cortlandt Street, New York City. Mr. Vredenbergh is of counsel to the Pennsylvania Railroad in New Jersey, which is interested in the tunnel project.

MR. REYNOLD JANNEY has resigned the superintendency of the Locomobile works at Bridgeport, Conn., to accept the position as manager of the Edison Storage Battery works at Glen Ridge and Silver Lake, N. J. The employees of the Locomobile Company expressed their appreciation of Mr. Janney's services and the high esteem in which he is held by his associates by presenting him with an elegant tea service and a beautiful water color. The best wishes of his many friends go with him in his new position.

MR. HUGH L. COOPER, some time hydraulic engineer of the Stilwell-Bierce & Smith-Vaile Company, and now chief engineer of the Mexico Electric Light & Power Company, which is building an hydraulic plant at Necaxa with an initial capacity of 45,000-hp to generate current in the first instance for transmission 90 miles to Mexico City, has left for Mexico after a short visit to New York. As already mentioned in these columns the turbines have been ordered abroad and it is very probable that the generators will also be built in Europe.

MR. LOUIS SIMPSON, of Ottawa, Ont., has recently visited the United States for the purpose of investigating the merits of the different electrical furnaces. He is confident that the electrical reduction of iron ores, and their conversion into steel, is a commercial possibility under the conditions which exist in the Ottawa valley and near the city of Ottawa. The difficulty seems to be only in the collection of sufficient data in order to decide which of the several different furnaces and processes are the best to adopt. Mr. Simpson is continuing his invesitgations with a view of utilizing some of the immense water power at the Chats Falls, within twenty miles of the city of Ottawa, for the purpose of producing iron and steel.

ALLIS-CHALMERS PERSONNEL.—According to advices from Milwaukee important changes have been announced in the officials of the Allis-Chalmers Company and others are still to be made. Probably the most important change is the coming appointment of G. O. Dixon, of Scranton, Pa., as general manager of all the plants. Mr. Dixon was formerly at the head of the Scranton Company, which became a part of the engine-building consolidation. David Harlowe, of Milwaukee, formerly superintendent of the Clinton Street works of the E. P. Allis Company of Milwaukee has been named as general transfer manager of the company, with authority at every plant. William P. Harper, assistant purchasing agent of the company, has been promoted to general purchasing agent. This position has been held by H. F. Young of the Gates works.

MR. G. MARCONI, who has been working at wireless telegraphy at Glace Bay, N. S., is to sail for England on the *Lucania*, on October 3, from New York, where he will do some more experimental work. He is quoted as saying: "The new improvements will necessitate some changes, but whether they will eventually do away with the tower system I am not prepared to say. The improvements will be distinctly for the better in speed and accuracy. My new inventions will mean big improvements in the whole system of wireless telegraphy. Upon my arrival in England similar improvements will be installed in the station there, and if my anticipations are realized, as I feel certain they will be, the inauguration of wireless telegraphy for commercial purposes will follow very shortly afterward. My experiments on the *Lucania* will be conducted with Table Head in particular, carrying on the work until the English coast is reached."

MR. LOUIS DE GOLL, president of the Rowland Telegraphic Company, of Baltimore, who has been abroad for the last six months on business connected with the introduction of the company's system, which is the invention of the late Professor Rowland, of the Johns Hopkins University, has returned home from his travels, greatly encouraged by his European experiences. Mr. De Goll spent his time principally on the Continent, and visited a number of countries in the interest of his company. He also attended the sessions of the International Telegraphic Congress, which was held in London last May. Mr. De Goll will remain in Baltimore for a while, but expects to return to Italy after some weeks in connection with the further introduction of the Rowland system in that country. The apparatus installed in Italy is now working on the line between Rome and Naples under the conditions of actual service, and has for about three months past been sending messages from 10 o'clock in the morning to 10 o'clock at night daily. The number of messages being handled is more than double that stipulated in the contract. At the time of the death of His Holiness Pope Leo XIII, the extraordinary pressure of business on this line was handled almost entirely by the Rowland installation.

Trade Notes.

EXHAUST HEADS IN UTAH.—The plant of the Utah Light & Power Co., Salt Lake City, has just been equipped with Burt exhaust heads by the Burt Mfg. Co., Akron, Ohio.

THE NERNST LAMP COMPANY, of Pittsburg, has recently established an agency for the sale of Nernst lamps and supplies with the W. G. Nagel Company, Toledo, Ohio, this company having, for several years, acted as selling agent for the Westinghouse Electric & Mfg. Company.

"SOLDERING SENSE," is the pithy title of a pithy little pamphlet issued by the L. B. Allen Company, of Chicago, in regard to the merits of its Allen soldering sticks about which a good deal of information is given in brief form for the benefit of electrical workers of all kinds. The Allen soldering paste is in big popular demand.

CROCKER-WHEELER COMPANY, of Ampere, N. J., has issued a very neat and artistic bulletin in regard to its railway generators. It is a quarto pamphlet on deckle edge embossed cover, with a photo print of one of its generators tipped on the first outside cover page. The contents are illustrations of the machine in detail, with a brief specification of the features of each part.

CIRCUIT BREAKERS.—In an attractively designed catalogue (No. 6005) the Western Electric Company describes its automatic circuit breakers for direct current. In the construction of these circuit breakers ample copper is provided in the laminated brushes and in the coils, and in their design the three principal features aimed at are reliabilty, simplicity and strength. The catalogue is well illustrated with half-tone views and diagrams, the latter giving the dimensions and other data of breakers of different capacities and types. Price lists, code words, etc., are tabulated.

EXPENSIVE FEED-WATER.—Owing to the absence of any water supply in the gold mining regions of West Australia, all water used was formerly shipped by rail from near the coast, several hundred miles distant. An electric lighting and power plant in the mining country formerly paid $1.80 per hundred gallons, though at one time the price was as high as $7.00 for that quantity. At present water is pumped through a pipe line nearly 200 miles long by a Worthington pumping plant, at the coast, and is sold at the rate of $1.80 per 1,000 gallons.

ARCTIC SPORTS IN SUMMER.—The North Electric Company held a field day and picnic at Silver Lake, thirty-five miles south of Cleveland, on Saturday, September 18. The programme received indicates that however chilly the participants may have been on arrival, they had a very warm time subsequently. A long programme of athletic sports was carried out most successfully, and Mr. F. F. Sapp officiated as starter. The identity of the umpire remains concealed, but as he was as big as a house, it is believed he escaped with his life. The thrilling baseball game was won by the Polar Bears over the North Stars with a score of 7 to 2. Mr. W. North captained the winning team. The prize is a permanent challenge trophy silver cup, which will be played for by the teams of this prosperous telephone manufacturing concern each year. The party went and returned in a special train of ten coaches. Many of the competitions were open to and were won by ladies.

"EXIDE BATTERY."—This well-known battery is so extensively used that the Electric Storage Battery Company has very wisely issued a 32-page pamphlet containing rules for the care of the battery. By strictly following the rules laid down the best possible results will be obtained from the battery. The information contained will be found very useful indeed to those having charge of this type of battery. Two tables show the rate of charging and the voltages when charging. An important part of the text matter is that relating to automobile batteries. Full directions are given for charging them; removing them from vehicles, and for putting them out of commission. The general rules for the proper care of a battery are very carefully drawn up and complete and are the result of many years experience and observation. The last nine pages of the pamphlet contain illustrations of the plates, separately and in groups, and of assembled cells, besides detail parts.

A PERPETUALLY UP-TO-DATE CATALOGUE.—The F. Bissell Company, Toledo, Ohio, has made a new departure in catalogue-making. Its latest catalogue is of the "loose-sheet" style, which, permits the addition of the company's new bulletins and price-lists as they are received, and the removal of obsolete ones. The bulletins just put out in this form are bound in a substantial temporary binder of excellent design. When bound in this way the bulletins are as firmly secured and as readily handled as if they were bound in book form after the conventional style. The bulletins cover everything dealt in by the company. It handles electrical supplies and machinery in general, including apparatus and supplies for lighting, power, railways, telephones, dynamos, motors, switchboards, etc. The catalogue is very complete and nothing in the different lines seems to have been omitted in the make up. All the goods listed are illustrated, and a telegraph code enables the purchaser to indicate by this means any particular article. This form of catalogue will no doubt be received with satisfaction by the trade.

A WIRELESS DEMONSTRATION.—The skepticism of which many hundreds of people had in regard to the commercial wireless telegraph theme took flight when they were invited to send messages from the Thos. E. Clark Company's two stations located in Pontiac at the Michigan State Agricultural Association grounds. Hundreds of messages were sent and received without one mistake. It proved to be one of the greatest attractions at the successful State Fair. The company holds a copy of all messages sent and received and the signatures of some of the most prominent men in Michigan and other states can be seen on the telegraph blanks. Many complimentary remarks as well as good wishes were showered upon the operators. Any one desiring an article on "Space Telegraphing" or a description of this Company's instruments will be supplied by sending stamp to its general office, 71 Michigan Ave., Detroit, Mich. This company is also manufacturing a special wireless spark coil for automobiles, gas and gasoline engines, together with X-ray coils, and all lines of electrical specialties.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 15, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

738,193. TROLLEY POLE OF ELECTRIC TRAM CARS OR THE LIKE; Carl R. F. Hommel and Reinholdt J. Hommel, Fredericksberg, Copenhagen, Denmark. App. filed Jan. 15, 1903. The rise of the trolley above the wire trips a dog and releases a spring which retracts the trolley pole.

738,747. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; Harry M. Acly, Pittsfield, Mass. App. filed Jan. 31, 1903. The upper part of the holder is pivoted to the lower part and contains the spring and the adjusting devices therefor, so that when the brush is to be removed, the upper part can be tipped back to allow it to come without altering the spring adjustment.

738,752. ELECTRIC SWITCH; Allen H. Babcock, Oakland, Cal. App. filed March 23, 1903. A field switch having one position of the switch blade for starting, a second position for running and a third position for discharging the field current.

738,782. DYNAMO ELECTRIC MACHINE; Edgar A. Edwards, Cincinnati, Ohio. App. filed Dec. 9, 1901. That portion of the casing covering the commutator is hinged and provided with a handle so that it can be easily opened.

738,792. MANHOLE TERMINAL FOR CONDUIT SECTIONS; Guy M. Gest, Cincinnati, Ohio. App. filed Jan. 23, 1903. An outwardly curved or flaring flange made in sections and adapted to fit around the end of the conduit and held in place by the machinery of the manhole.

738,801. ELECTROMAGNET; Carl M. Hedman, Chicago, Ill. App. filed Jan. 2, 1902. To obtain an adjustment of the stroke of the armature without bodily adjusting the armature itself, a screw is fixed in the armature opposite the pole piece and is adjustable to limit against the pole piece.

738,803. THERMAL CUT OUT OR CIRCUIT CHANGER; Gustavus E. Hoglund, Chicago, Ill. App. filed July 1, 1902. A heating coil surrounds a fusible conductor at the point where the fuse is weakest to concentrate the heat at that point.

738,824. ELECTRIC LOCK; William MacMillan, New York, N. Y. App. filed July 29, 1902. An electro-magnet is arranged inside of the lock and retains the bolt until it has been energized.

738,862. INSULATED JOINT FOR RAILROAD RAIL SECTIONS; George A. Weber, New York, N. Y. App. filed Sept. 20, 1902. Details.

738,864. TRANSFORMER; Roy R. Wiley, St. Catharines, Canada. App. filed Jan. 24, 1903. The windings are made in sections and strung upon a core in inclined position with respect to each other to afford heat-radiating surfaces between them of such shape as to uniformly cool the apparatus.

738,870. ELECTRIC REGULATOR; Gilbert Wright and Harry M. Acly, Pittsfield, Mass. App. filed Jan. 31, 1903. A pivoted arm carries contacts at each end adapted to engage with a set of fixed resistance terminals, one end of the arm only engaging the terminals at the same time. A reversing switch is actuated when a different end of the arm is presented to the terminals.

738,871. SPEED REGULATING DEVICE; Magnus W. Alexander, Lynn, Mass. App. filed June 5, 1903. The armature shaft drives an oil pump in which the movement of the liquid is more or less throttled. A variation of speed alters the pressure on the liquid and causes a piston to move in one direction or the other to cut in or out a regulating resistance.

738,874. ELECTRIC FUSE; George B. Baby, St. Catharines, Canada. App. filed May 2, 1903. Details of an inclosed fuse operating in a tube containing oil.

738,896. ARC LAMP; Walter C. Fish, Lynn, Mass. App. filed June 12, 1901. The mechanism includes a magnet for striking the arc, an opposing magnet, and means for causing the current in the opposing magnet to lag behind with respect to the current in the main magnet.

738,897. HYDRO-ELECTROTHERAPEUTIC APPARATUS; Daniel C. Fisher, Boston, Mass. App. filed Oct. 21, 1902. A tubular apparatus for attachment to a water-pipe and source of current whereby an external application of both water and electricity can be directed to any part of the body.

738,902. ELECTRIC METER; Ludwig Gutmann, Peoria, and Robert C. Lanphier, Springfield, Ill. App. filed Aug. 26, 1902. A rotating magnetic field rotating synchronously with an inclosed armature acts at opposite sides of the path of rotation upon a suitable external armature mounted upon an oscillatory axis.

738,906. TRACK INSTRUMENT FOR RAILWAY SIGNALING; Lewis R. Hummel, Omaha, Neb. App. filed Aug. 29, 1902. A box placed beside the rail and having a cover adapted to be depressed by the car wheel to alter the condition of a circuit closer contained in the box.

738,908. THERMAL CUT OUT OR FUSE FOR ELECTRIC CIRCUITS; Rudolf Hundhausen, Wilmersdorf, Berlin, Germany. App. filed Dec. 15, 1899. To prevent metal particles from flying about when the fuse is ruptured it is packed in talcum powder which, it is stated, absorbs the scattering particles.

738,909. NON-INTERCHANGEABLE CONTACT PARTS; Rudolf Hundhausen, Wilmersdorf, Berlin, Germany. App. filed Feb. 19, 1900. To be able to make the parts of a fuse plug and socket uniform in dimensions, notwithstanding the various capacities of the plug, and to prevent the insertion of a plug of the wrong capacity into a socket, certain limiting shoulders are applied at positions on the plug to correspond with the capacity of the plug and prevent its entering a socket not intended for it.

738,919. SUSPENSION OF TROLLEY WIRES; Martin T. A. Kubierschky, and P. Herkner, Berlin, Germany. App. filed June 8, 1903. The ends of the wires are passed into the clip and caught by wedge-shaped keys which increase their grip with the tension on the wire.

738,926. TROLLEY; Harry E. Myers, Kittanning, Pa. App. filed Oct. 13, 1902. A guard to keep the wheel on the wire.

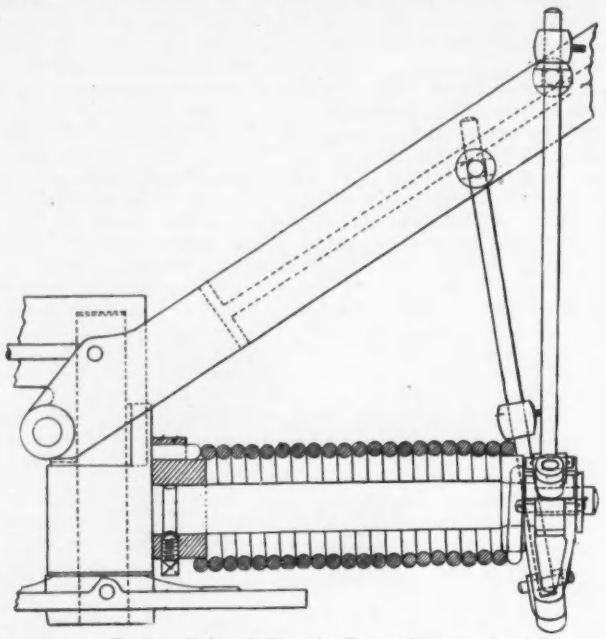
738,941. SNAP SWITCH; Robert H. Read, Schenectady, N. Y. App. filed June 22, 1903. Two blades which enter the same clip are connected together by a spring which is put under tension to lift the second blade only after the first has fully withdrawn from the clip.

738,942. STORAGE BATTERY; Frederick A. Redmon, Chicago, Ill. App. filed March 16, 1903. (See page 524.)

738,952. ELECTRIC SWITCH; William H. Spiller, Holyoke, Mass. App. filed Sept. 25, 1902. Details of construction.

738,963. BURGLAR ALARM; Ferdinand Walder, Rochelle Park, N. J. App. filed June 5, 1903. Details.

738,969. ELECTRIC SWITCH; Benton W. Woldride, Trenton, Mo. App. filed May 19, 1903. A switch for holding a telephone wire arranged so



738,193.—Trolley Pole of Electric Tram Cars or the Like.

that the wire can be dropped quickly during a storm to prevent a lightning charge from reaching the instrument.

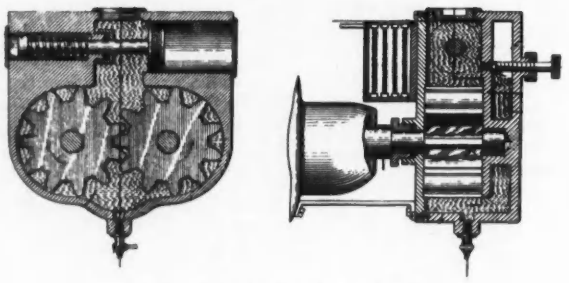
738,970. RHEOSTAT; William C. Yates, Schenectady, N. Y. App. filed Jan. 5, 1903. The resistance units are each inclosed in a sheet metal casing insulated therefrom to rapidly conduct away the heat.

738,988. LIGHTNING ARRESTER AND PROTECTOR; John Davis, Sterling, Ill. App. filed Oct. 20, 1902. Where carbon electrodes are used the material is corrugated so that the dust created by arcing will fall away from the ridges into the depression, and thus not interfere with the air gap.

739,001. CONDUCTIVITY BRIDGE; William Hoopes, Pittsburg, Pa. App. filed Jan. 5, 1903. An apparatus for determining the specific conductivity of conductors consisting of a bridge provided with conductivity measuring means and a scale indicating directly the percentage conductivity of the conductor under test.

739,005. POWER DRIVEN MACHINERY; Dugald C. Jackson, Madison, Wis. App. filed Feb. 16, 1903. The reversal required in planing machines and similar machinery is accomplished in this instance by reversing an electric motor which drives the machine.

739,032. ELECTRIC RAILWAY; Willis N. Stewart, London, England. App. filed Nov. 24, 1902. The train carries main and auxiliary motors, the former being supplied by storage battery on the train, and the latter tak-



738,871.—Speed Regulating Device.

ing current from a roadside conductor at points only where additional power is required.

739,052. SWITCHBOARD; Benjamin Beerwald, New York, N. Y. App. filed May 26, 1903. An apparatus facilitating the operation of theatre dimmers.

739,056. MAKE AND BREAK SWITCH FOR ELECTRIC SIGNALS; Charles B. Campbell, Waterloo, Iowa. App. filed Jan. 20, 1903. Details of a circuit closing device attached to a trolley wire and adapted to be operated by the trolley wheel.

739,057. AUTOMATIC SIGNAL FOR ELECTRIC RAILWAYS; Charles B. Campbell, Waterloo, Iowa. App. filed Jan. 20, 1903. Details.

739,066. CIRCUIT BREAKER FOR AUTOMATIC ELECTRIC RAILWAY SIGNALS; Roy A. Doty, Waterloo, Iowa. App. filed March 31, 1903. A mechanism intended to open the circuit through the signal light without short circuiting, after a predetermined number of cars have left a block upon which they have been moving.

739,075. LOCKING MECHANISM; Rudolph W. Goeb, St. Louis, Mo. App. filed Oct. 13, 1902. Details of a locking mechanism for a coin operated telephone.

739,077. INSULATED RAIL JOINT; John J. Gunn, Ypsilanti, Mich. App. filed May 26, 1902. The insulated joint is supported by a section of rail reversed and applied against the bottom of the joint.

739,126. BAROMETER ALARM; Guillermo Vives, Ponce, Porto Rico. App. filed Dec. 3, 1902. Contacts are placed in the path of movement of the index barometer to close an alarm circuit at predetermined times.

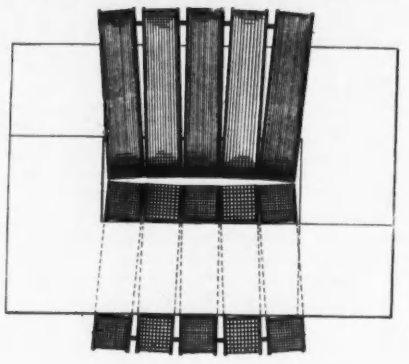
739,128. POLE CHANGER; Thomas W. Warner, Muncie, Ind. App. filed Sept. 7, 1901. The object of this invention is to provide a system of wiring from the pole changer to produce three different kinds of current, namely, positive and negative pulsating currents, and alternating currents to be used for ringing telephone bells.

739,139. ELECTROLYTIC PROCESS OF RECOVERING METALS FROM THEIR COMPOUNDS; Charles E. Baker and Arthur W. Burwell, Cleveland, Ohio. App. filed Nov. 11, 1902. The process involves electrolysis of a solution of the metallic compound with a mercury cathode, distillation of the resulting amalgam to volatilize and separate the mercury from the metal to be recovered and condensation and return of the mercury to the electrolytic cell.

739,140. APPARATUS FOR OXIDIZING METALS DISSOLVED IN MERCURY; Charles E. Baker and Arthur W. Burwell, Cleveland, Ohio. App. filed November 11, 1902. (See page 524.)

739,147. INSULATOR FOR ELECTRIC WIRES; Herman Bottjer, Augusta, Ga. App. filed Oct. 23, 1902. A socket in the head of the insulator in which the wire is confined by a threaded cap.

739,164. TROLLEY; Elmer E. Frederick, Easton, Pa. App. filed April 30, 1903. The ordinary trolley wheel is replaced by three metal balls between which the wire runs, the balls being set in ball bearings.



738,864.—Transformer.

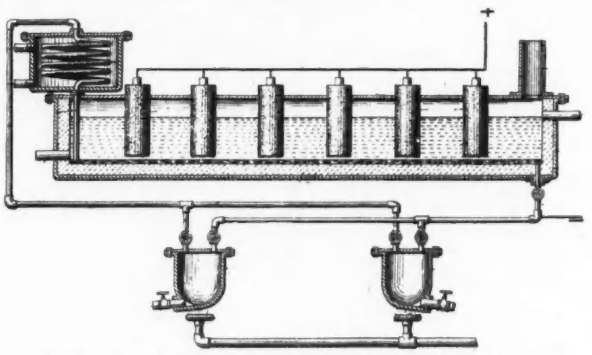
739,176. ELECTRIC WATER HEATER; William E. Heal, Marion, Ind. App. filed March 29, 1900. A carbon tube passes through a water tank and serves as a heating resistance for the water; a contact traverses the tube to regulate the amount of heat.

739,179. TROLLEY ALARM AND INDICATOR; William H. Hillyer, Atlanta, Ga. App. filed July 19, 1902. An annunciator showing when the trolley is off the wire.

739,181. ELECTRIC RESISTANCE APPARATUS; Robert Hopfelt, Berlin, Germany. App. filed Jan. 28, 1902. Metal plates with carbon facings having between them a resistance mass of pulverized carbon, which is adapted to give coherer action when the current passes.

739,186. CONTROLLER FOR ELECTRIC MOTORS; Charles W. Kennedy, Rutledge, and Francis A. Pocock, Landsdowne, Pa. App. filed April 15, 1902. Where two motors are geared to the same vehicle, the controller is constructed to change the circuits of one motor at a time, so that changes in speed will be less sudden.

739,204. ELECTRIC LIGHTING SYSTEM; James F. McElroy, Albany, N. Y. App. filed Oct. 22, 1902. A train lighting system in which the reg-



739,139.—Electrolytic Process of Recovering Metals from their Compounds.

ulating device is a magnet in the main circuit in series with both lamps and battery and whose action is adjusted by means of a supplementary reversely wound coil contained in the lamp circuit only.

739,205. AUTOMATIC SWITCH; James F. McElroy, Albany, N. Y. App. filed Jan. 13, 1903. A switch that is positively thrown to one side or the other by the engagement therewith of a pawl carried by the dynamo shaft, the engagement being controlled by a cam which acts upon reversal of the shaft, the switch being used on an axle-driven dynamo.

739,223. TROLLEY HARP; Harrie A. Ripley, Westdale, Mass. App. filed Jan. 26, 1903. Details.

739,251. ELECTRICITY METER; Leonard J. Aron, Birmingham, England. App. filed Feb. 6, 1903. In a two-clock meter, one of the clocks as affected by the current to be measured and the other runs at normal time and a double rating or rate changing device is controlled by the normal time clock.

739,272. ELECTRIC ALARM LOCK; Otto E. F. Himmighoefer, St. Louis, Mo. App. filed Feb. 9, 1903. A pair of contacts are set into an ordinary lock so that the turning of the knob or of the key will close an alarm circuit.